

ROTIFERA FROM AUSTRALIAN INLAND WATERS V. LECANIDAE (ROTIFERA: MONOGONONTA)

by W. KOSTE*, & R.J. SHIEL†

Summary

KOSTE, W., & SHIEL, R.J. (1990) Rotifera from Australian inland waters. V. Lecanidae (Rotifera: Monogononta). *Trans. R. Soc. S. Aust.* 114(1), 1-36, 31 May, 1990.

Diagnostic keys are given to genera and species of the rotifer family Lecanidae (*Hemimonostyla*, *Monostyla*, *Lecane*) recorded from Australian inland waters. All species are figured and available distribution data and ecological information given. Some widely-distributed taxa not yet recorded from the continent are included.

KEY WORDS: Rotifera, taxonomy, Australia, known species, Lecanidae

Introduction

In this part of our revision of the Australian Rotifera (Koste & Shiel 1986b, 1987b, 1989a, b) we review the Australian representatives of the family Lecanidae (*Monostyla*, *Hemimonostyla*, *Lecane*), which generally are littoral (epiphytic or epibenthic) in habit. They are common in the shallow vegetated areas of billabongs and other wetlands, with some species (*Monostyla lunaris*, *Lecane luna*) occurring regularly in the plankton communities of open water. In eight billabongs of the Magela Creek, for example, Tait *et al.* (1984) recorded 16 species of *Lecane/Monostyla* from a single net tow in Mine Valley billabong (13.vi.79). Such high species diversity is exceptional, a result of concentration as the dry season progressed; more commonly, in temperate Australia, two to four congeners in a collection may be expected.

Diagnostic keys, brief descriptions and figures of all known Australian representatives of the family are provided to enable identification of species. Some widely distributed taxa not yet recorded from Australia are included. The format follows that of earlier parts; dichotomous keys are followed by individual species' descriptions and known Australian records. Relative abundance is indicated by: "common" (more than 30 widely dispersed records), "uncommon" (10-30 localities), "rare" (<10 records). Brief ecological data are included where available. Early Australian records cited in Shiel & Koste (1979) are not repeated here, nor are the majority of northern hemisphere citations given by Koste (1978), which contains a detailed treatment of the Rotifera outside Australia. Keys to families are included in Koste & Shiel (1987b).

Family Lecanidae Bartos

The family was erected by Bartos (1959) to

separate the genus *Lecane* from the taxonomic group containing *Proales*, *Proalinopsis*, *Bryceella* and *Tetrasiphon*. The subgenus *Hemimonostyla* was created to accommodate lecanids with incomplete fusion of their toes (Bartos 1959: 497-499). *Monostyla* (Ehrenberg), with a single toe, had previously been relegated to subgeneric status (Edmondson 1935). Not all subsequent reviewers accepted subgeneric status for the three groups; their differences are now considered to be sufficiently distinct to warrant generic separation (W.T. Edmondson pers. comm.). Accordingly, we have separated *Monostyla*, *Hemimonostyla* and *Lecane* (s. str.) in the following keys, and rather than provide an exhaustive synonymy, note here that in previous references to species of *Monostyla* and *Hemimonostyla*, authors may have referred either to their nominate genera or *Lecane* (M.)/*Lecane* (H.) respectively (cf. Koste 1978).

Lorica undivided; foot with three segments, first two fused with ventral plate, only distal segment moveable; one or two toes with free or more or less fused claws. Corona with supraoral buccal area, most without pseudotrochus; mastax malleate, but also capable of a virgate function by means of strong muscles attached to the inner pharyngeal wall. Three genera are recognized in the family.

Key to genera of the family Lecanidae

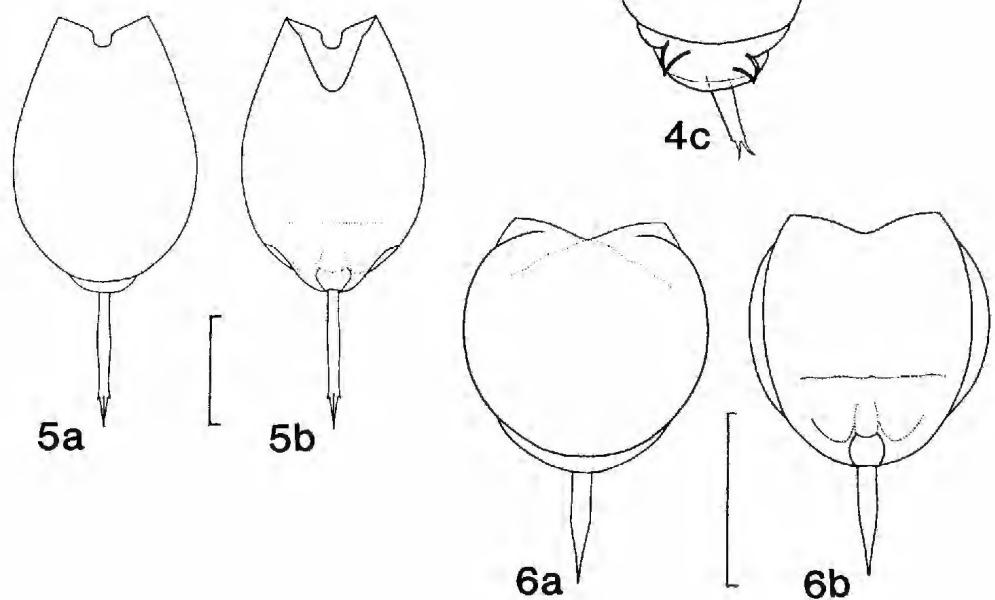
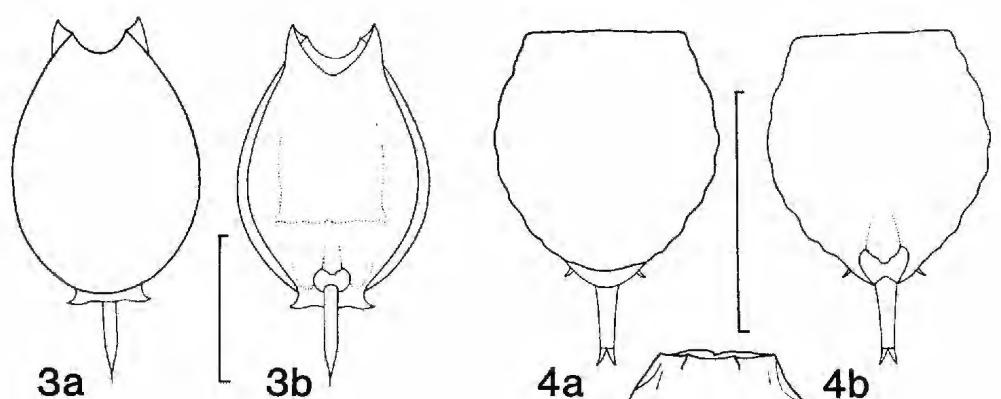
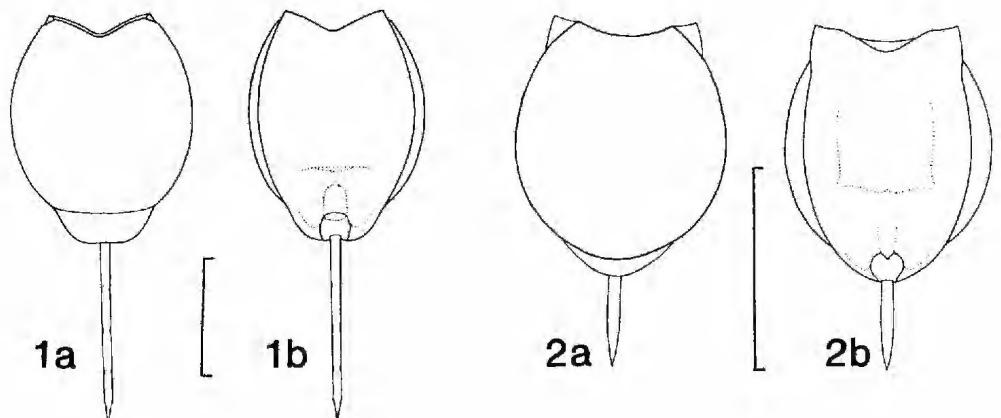
1. Two toes, separated along their full length (Fig. 6:5a)..... *Lecane* Nitzsch, 1827
2. Single toe or toes partly fused..... 2
2. Distal half of toes separated (Fig. 6:3)..... *Hemimonostyla* Bartos, 1959
3. Single toe (Fig. 6:1)
- *Monostyla* Ehrenberg, 1830

Key to species of the genus *Monostyla*

1. Toe with two claws or a single fused claw... 2
2. Toe without claw..... 20
- 2(1). Dorsal lorica anterior margin with median curved spines..... *M. quadridentata* Ehrenberg
- 2(2). Dorsal lorica margin without median spines... 3
- 3(2). Lorica anterior margin(s) more or less deeply

* 5 Ludwig-Brill-Strasse, Quakenbrück D-4570, Federal Republic of Germany.

† Murray-Darling Freshwater Research Centre, P.O. Box 921, Albury, N.S.W. 2640.



- sinuata* 12
Lorica margin(s) relatively straight +
 4(3). *Claws held tightly together, or fused with only a median groove* 6
Claws diverging, immobile (Fig. 1:4) 5
 5(4). *Ventral lorica with paired posterolateral spines ("hip spurs")* *M. bifurca* Bryce
Ventral lorica without hip spurs *M. furcata* Murray
 6(4). *Toe with only one claw, or indistinct dividing line* 7
Claws separate (Fig. 4:3) *M. obtusa* Murray
 7(6). *Dorsal lorica with distinct striations/patterning/ornamentation* 8
Dorsal lorica smooth 10
 8(7). *Dorsal and ventral surfaces heavily wrinkled and folded; total length <85 µm* *M. rugosa* Haring
Regular facettation, less distinct; lorica >90 µm 9
 9(8). *Dorsal facettation regular, each facet bounded by double longitudinal lines; ventral lorica patterned* *M. tethis* Haring & Myers
Only anterior facet row regular, no double boundaries; no ventral pattern (single transverse fold in front of foot)
M. elachis Haring & Myers
 10(7). *Ventral plate constricted just behind anterior margin* *M. subulata* Haring & Myers
Ventral plate not constricted 11
 11(10). *Toe spindle-shaped, widest in the middle (Fig. 2:1)* *M. copeis* Haring & Myers
Toe tapers evenly (Fig. 4:6) *M. scutata* Haring & Myers
 12(3). *Dorsal and ventral anterior margins concave* 14
Dorsal margin straight, ventral with sinus 13
 13(12). *Ventral sinus shallow, with strongly convex sides, externally with two short, stout, incurved hooklike frontal spines (Fig. 5:2)*
M. stenroosi (Meissner)
U-shaped shallow sinus flaring anteriorly; sides not convex; frontal spines absent (Fig. 6:1)
M. unguifera Fadeev
 14(12). *Lorica outline nearly circular (Fig. 2:2)* *M. cornuta* (Müller)
Lorica outline oval to geoid 15
 15(14). *Lorica ovoid, tapers to narrow head aperture (<½ body width) (Fig. 1:5)* 16
Lorica subcircular to elongate oval, taper less acute; head aperture wide (> ½ body width) (Figs. 3:3 5:5) 17
 16(15). *Toe long, slender, ca. ¼ body length; claw ¼ toe length* *M. bulla* Gisèle
Toe > ½ body length; claw extremely long, > ½ toe length *M. stylax* Haring & Myers
 17(15). *Lorica <120 µm; toe > ½ body length, long, thin, parallel-sided* 18
Lorica >200 µm; toe < ½ body length, stout with medial bulge
 *M. lamellata thalera* (Haring & Myers)
 18(17). *Dorsal and ventral anterior sinuses deep* 18
Dorsal margin only slightly concave; ventral margin with deep U-shaped sinus with convex sides *M. crenata* Haring
 19(18). *Identical broadly V-shaped sinus in both dorsal and ventral margins, latter projects slightly beyond dorsal margin (Fig. 1:1a)* *M. acus* Haring
Ventral sinus deeper than dorsal, rounded at posterior margin (Fig. 3:3)
M. lunaris (Ehrenberg)
 20(1). *Lorica with lateral curved spine-like processes*
Lateral processes absent 21
 21(20). *Lorica anterior margin with more or less large frontal corner cusps/spines* 23
Front corner cusps absent 22
 22(21). *Ventral lorica margin somewhat concave* 24
Ventral lorica margin straight
M. pyriformis Daday
 23(22). *Ventral lorica plate in upper third bilaterally constricted* *M. arcuata* Bryce
Ventral lorica plate not constricted
M. closterocerca Schmidta
 24(22). *Head aperture margins straight, coincident; corner spines small* *M. opia* Haring & Myers
Head aperture with dorsal and ventral sinuses of different size; corner spines large 25
 25(24). *Posterior segment of ventral lorica with sinuate margin and two lateral acute triangular cusps*
M. batillifer Murray
Posterior margin smoothly oval or elliptical 26
 26(25). *Dorsal lorica surface smooth, unornamented*
Dorsal lorica with regular well-marked facets (Fig. 3:2a) *M. hamata* Stokes
 27(26). *Head aperture with deep, coincident dorsal and ventral margins, flanked by pointed cusps (extensions of ventral lorica)*
M. decipiens Murray
Dorsal anterior sinus shallow, rounded posteriorly with convex edges; ventral sinus a much deeper, narrow cleft (Fig. 5:1b); truncate rather than pointed anterior corners of ventral plate
M. sinuata Häuer
Monostyla acus Haring
 FIG. 1:1

Monostyla acus Haring, 1913, p. 398, Pl. 36, Figs 1–3.
Lecane (M.) acus: Myers 1937, p. 4.

Diagnosis: Head opening with V-shaped sinuses dorsally and ventrally, latter projecting slightly beyond dorsal plate margin; posteriorly, ventral plate extends beyond dorsal margin as broad shield over foot; lateral sulci deep; toe approx. 4/5 body length, slightly decurved; claw very long.

Total length 180 µm; dorsal plate 85 × 82 µm; ventral plate 100 × 72 µm; depth of anterior sinus

Fig. 1, 1, *Monostyla acus* Haring: (a) dorsal; (b) ventral. 2, *M. arcuata* Bryce: (a) dorsal; (b) ventral. 3, *M. batillifer* Murray: (a) dorsal; (b) ventral. 4, *M. bifurca* Bryce: (a) dorsal; (b) ventral. 5, *M. b. entoma* (Berzins), dorsal. 5, 6, *M. bulla* Gosse: (a) dorsal; (b) ventral. 6, *M. closterocerca* Schmidta: (a) dorsal; (b) ventral. Fig. 1:1, 2, 3, 4a-b, 5, 6, after Harring & Myers (1926); 4c, redrawn from Berzins (1982). Scale lines 50 µm.

10 μm ; posterior shield projection 15 μm ; distance between inner edges of lateral sulci 53 μm ; toe 64 μm ; claw 12 μm ; greatest depth of body 38 μm .

Distribution: Palearctic, Nearctic, Indonesia, acidophil in moor and *Sphagnum* pools. Rare: Tas. 16.5–17.0°C, pH 3.1–5.8, 46.2–80.6 $\mu\text{s cm}^{-1}$.

Literature: Koste 1978; Koste & Shiel 1986a.

Monostyla arcuata Bryce

FIG. 1:2

Monostyla arcuata Bryce, 1891, p. 206, text fig.

Lecane (M.) arcuata: Pax & Wulfert 1941, p. 143, Fig. 8.

Diagnosis: Head aperture dorsal margin slightly concave, ventral margin with shallow median sinus flanked by two straight sections; transverse fold of ventral plate anterior to foot; toe long and stout, > 1/4 body length, parallel sided or bulging slightly in middle, then tapering to point. Resembles *M. closterocerca* (Fig. 1:6).

Dorsal plate 45–69 \times 49–63 μm ; ventral plate 60–73 \times 41–50 μm ; toe 23–28 μm .

Distribution: Between moss and algae in springs and flowing waters. Rare: N.S.W., N.T., Qld., Vic. 10.5–28.5°C, pH 5.4–7.9, DO 6.0–10.1 mg l⁻¹, 23–750 $\mu\text{s cm}^{-1}$, 67 NTU, alkal. 2.7 mg l⁻¹.

Literature: Russell 1961; Koste 1978.

Monostyla batillifer Murray

FIG. 1:3

Monostyla batillifer Murray, 1913b, p. 458, Pl. 19, Fig. 2.

Diagnosis: Head aperture with deep V-shaped ventral sinus flanked by large spine-like cusps, dorsally with narrow, shallow U-shaped sinus; ventral plate constricted anteriorly; relatively deep lateral sulci; footplate small, narrow, undulate posteriorly with two distinctive laterally projecting, acutely triangular cusps, projects beyond dorsal plate; toe approx. 1/4 body length, parallel-sided for 1/4 of its length, conical posteriorly, ends in bristle-like point.

Total length 120 μm ; dorsal plate 85 μm long; ventral plate 95 μm ; anterior dorsal margin width 17 μm ; ventral margin width 26 μm ; toe 30 μm .

Distribution: Endemic, rare. Described from a pool near Sydney, later recorded also from the N.T.
Literature: Shiel & Koste 1979; Berzins 1982.

Monostyla bifurca entome (Berzins)

FIG. 1:4c

Lecane (M.) bifurca entome Berzins, 1982, p. 9.

Diagnosis: Original description and figure inadequate, but as we have not encountered this taxon, are reproduced here: "... the lorica does not [have] a straight frontal margin. It has a very small strong [?spindle] on the frontal corners, and the dorsal lorica has a short fold on the occipital

end. The dorsal frontal margin has two notches and the ventral margin has a shallow sinus in the middle." (Berzins 1982:9).

Dorsal plate 50 \times 45 μm ; ventral plate 55 \times 43 μm ; toe 18 μm .

Distribution: Endemic. Only record Creswick Creek, Vic.

Comment: The typical form, *M. bifurca* (Bryce 1892: 274) (Fig. 1:4a, b) is described as follows: Very flexible integument; body length approximately equals width; outline broadly oval; anterior margin straight; lateral sulci lacking; small posterior segment, extending beyond dorsal plate, carries two small lateral spines at sides of foot; toe > 1/4 body length, tapers distally; claw doubled, spread and immobile.

Dorsal plate 45–54 \times 42–52 μm ; ventral plate 48–58 \times 44–52 μm ; toe 15–19 μm ; claw 3.2–5 μm .

Comment: Of the integument, Harring & Myers (1926:416) noted that it "can not by any stretch of the imagination be called a lorica". *M. bifurca entome* appears loricate, with characteristic margin morphology markedly different from the nominate species. We retain the ssp. ranking as proposed by Berzins until further material is examined to determine if the variant as described represents ecotypic variation, or if specific status is warranted.

Monostyla bulla bulla Gosse

FIG. 1:5

Monostyla bulla Gosse, 1851, p. 200.

Lecane (M.) bulla: Wiszniewski 1954, p. 63.

Diagnosis: Head aperture with shallow V-shaped sinus dorsally, U-shaped notch at posterior margin of sinus for protrusion of dorsal antenna; ventral anterior margin with very deep sinus (Fig. 1:5.5b), rounded at posterior end; transverse fold on ventral surface in front of foot; toe long, ca. 1/4 body length, terminates in slender acute claw with basal spicules; claw with median line, undivided.

Dorsal plate 100–133 \times 74–105 μm ; ventral plate 93–140 \times 68–97 μm ; toe 48–85 μm ; claw to 20 μm ; resting egg 90 \times 70 μm .

Distribution: Cosmopolitan in littoral. Most common lecanid in Australia: eurytopic, pancontinental in billabongs, lake margins, and occasionally in the plankton of reservoirs and rivers, e.g. R. Murray (Shiel et al. 1982). 8.0–31.0°C, pH 3.5–9.4, DO 3.0–13.8 mg l⁻¹, 16–6, 600 $\mu\text{s cm}^{-1}$, <1–160 NTU.

Literature: Harring & Myers 1926; Koste 1978.

Monostyla closterocerca Schmarda

FIG. 1:6

Monostyla closterocerca Schmarda, 1859, p. 59, Pl. 14, Fig. 125.

Lecane (M.) closterocerca: Edmondson 1935, p. 302.

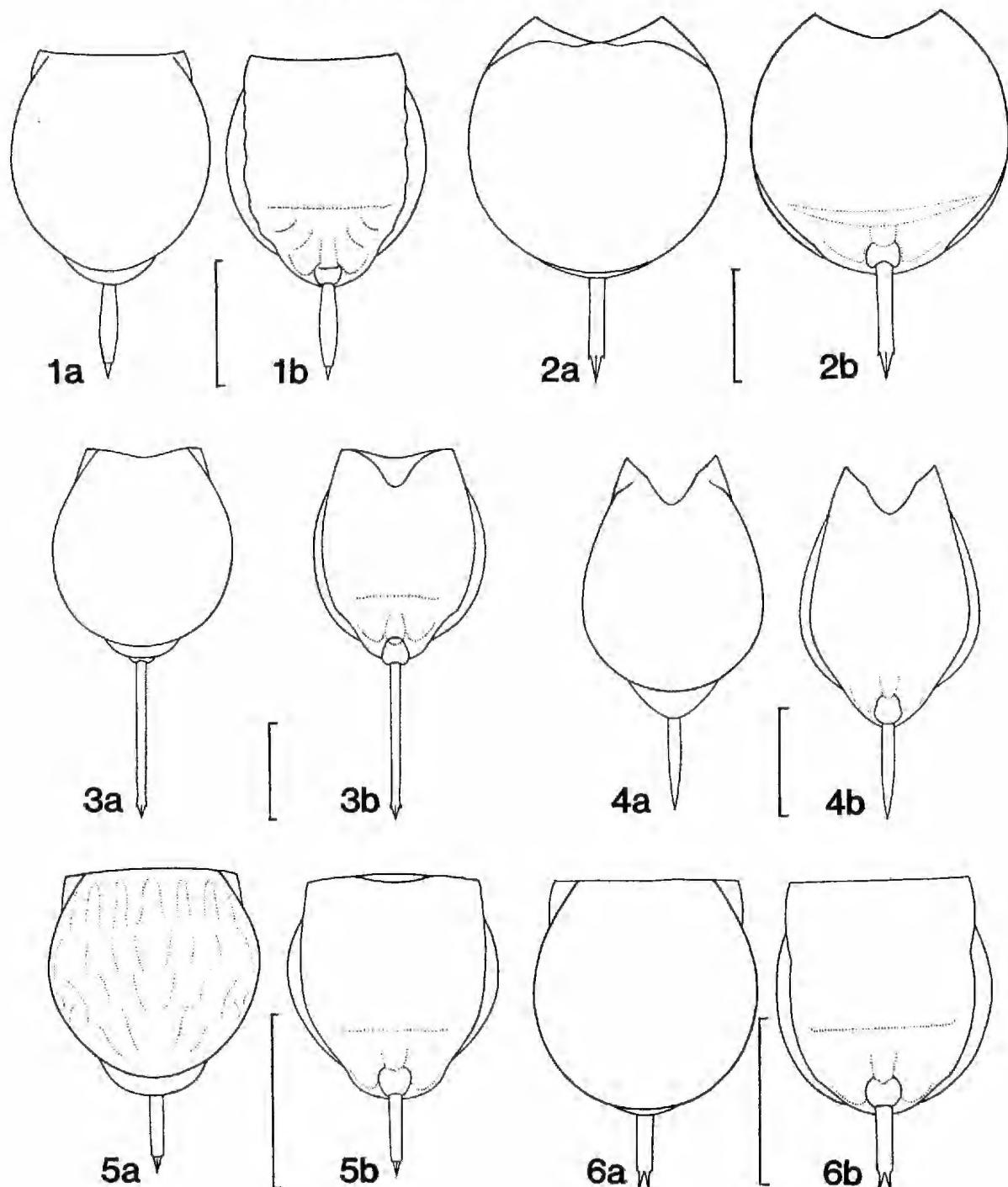
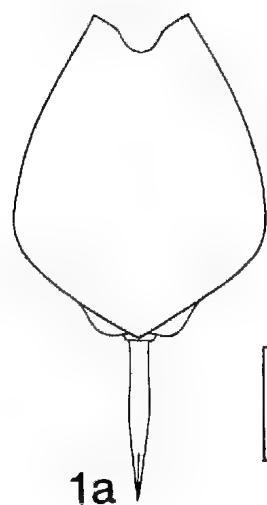
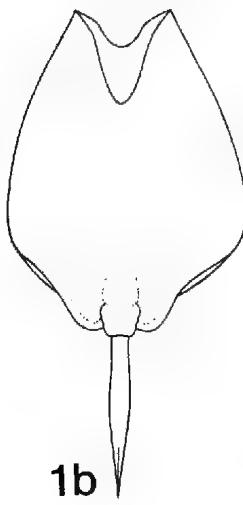


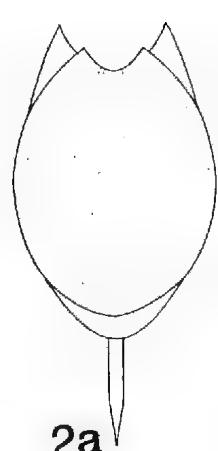
Fig. 2. 1, *Monostyla copeis* Herring & Myers: (a) dorsal; (b) ventral. 2, *M. cornuta* (Müller): (a) dorsal; (b) ventral. 3, *M. crenata* Herring: (a) dorsal; (b) ventral. 4, *M. decipiens* Murray: (a) dorsal; (b) ventral. 5, *M. elachis* Herring & Myers: (a) dorsal; (b) ventral. 6, *M. furcata* Murray: (a) dorsal; (b) ventral. Fig. 2: 1-6, after Herring & Myers (1926). Scale lines 50 μ m.



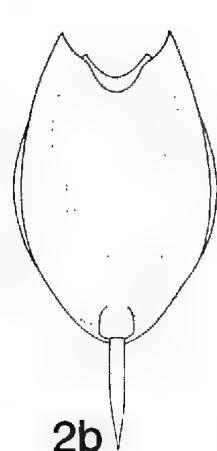
1a



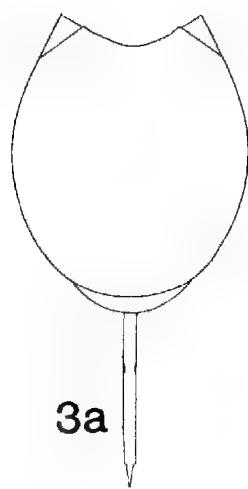
1b



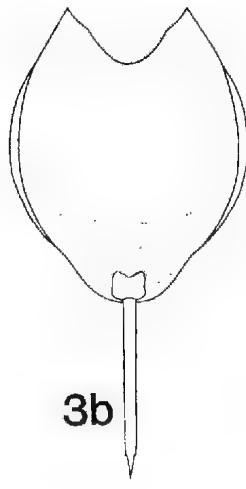
2a



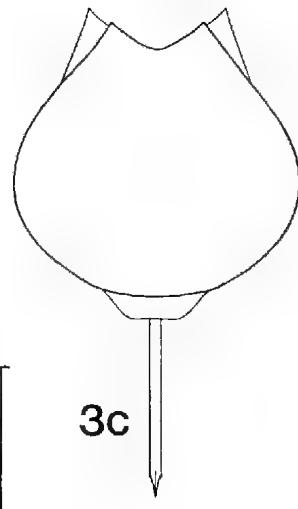
2b



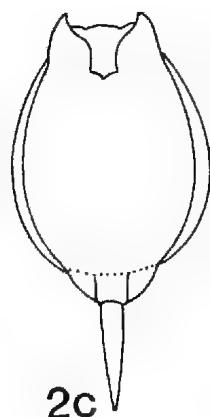
3a



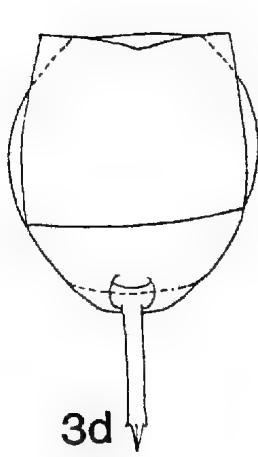
3b



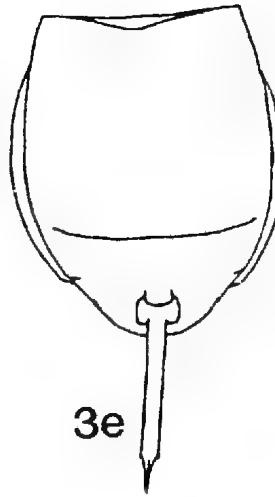
3c



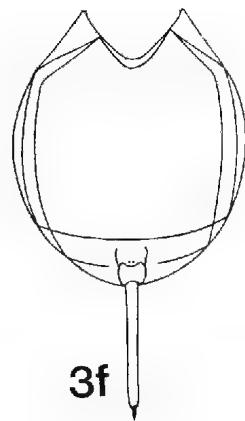
2c



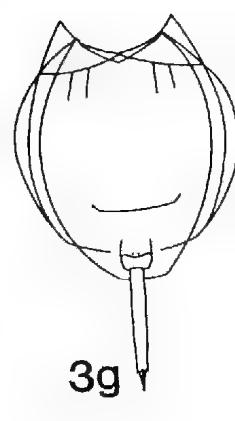
3d



3e



3f



3g

Diagnosis: Head aperture dorsal and ventral margins similar, shallow V-shaped sinuses with widely flaring convex sides; faint dorsal fold near apex of anterior sinus; transverse ventral fold in front of foot; lateral sulci shallow; toe long, <½ body length, parallel-sided for ½ length and tapering to slender acute point.

Dorsal plate 54-85×40-60 µm; ventral plate 57-82×39-49 µm; toe 21-38 µm.

Distribution: Cosmopolitan in standing and flowing waters, salinity tolerant (to 16 g l⁻¹). In Europe found in branchial chamber of *Astacus fluviatilis*.

Common: pancontinental. 11.8-26.0°C, pH 3.4-7.9,

DO 5.1-10.3 mg l⁻¹, 42-6, 120 µS cm⁻¹, 0.8-67 NTU.

Literature: Koste & Shiel 1987a.

Monostyla copeis Harring & Myers

FIG. 2:1

Monostyla copeis Harring & Myers, 1926, pp. 398-9, Pl. 51, Figs 1, 2.

Lecane (M.) copeis: Voigt 1957, p. 238.

Diagnosis: Head aperture margins coincident, slightly concave; transverse ventral fold in front of foot, short curved folds each side of foot; toe spindle-shaped, enlarged in middle, approx. ½ body length, terminating in stout acute claw.

Dorsal plate 75-88×72-80 µm; ventral plate 86-94×60-65 µm; toe 29-33 µm; claw 4-5 µm.

Distribution: Europe, N. America. Unconfirmed record from Vic.

Literature: Berzins 1982.

Monostyla cornuta (Müller)

FIG. 2:2

Trichoda cornuta Müller, 1786, p. 208, Pl. 30, Figs 1-3.

Monostyla cornuta Ehrenberg, 1830, p. 46.

Lecane (M.) cornuta: Edmondson 1936, p. 214.

Diagnosis: Head aperture with similar deep lunate dorsal and ventral sinuses; angles of sinuses obtuse, without spines; in retracted animal, dorsal fold obvious commencing at base of dorsal sinus, reaching margins behind anterior points; transverse fold in front of foot; toe parallel-sided, ca. ½ body length, terminates in large claw with median groove and two basal spicules.

Dorsal plate to 102×88-110 µm; ventral plate 85-128×105 µm; toe 38-46 µm; claw 8-10 µm.

Distribution: Cosmopolitan between submerged plants, periphyton. Rare: N.S.W., Qld.

Literature: Suzuki & Timms 1977; Shiel & Koste 1979.

Monostyla crenata Harring

FIG. 2:3

Monostyla crenata Harring, 1913, p. 399, Fig. 36:4-6.

Lecane (M.) crenata: Voigt 1957, p. 232.

Diagnosis: Head aperture slightly concave dorsally, ventral margin with deep sinus, rounded posteriorly; lorica lateral margins lightly convex, running to frontal corners; deep lateral sulci; toe extremely long, slender ½ body length, straight, parallel-sided, ending in short claw with two basal spinules.

Dorsal plate 90-120×75-105 µm; ventral plate 94-129×67-93 µm; toe 60-92 µm; claw 8-12 µm.

Distribution: Abundant in tropical and subtropical shallow littorals, thermophile. Rare: N.T., Qld, Vic. 22.5°C, pH 7.5, DO 7.8 mg l⁻¹, 1,080 µS cm⁻¹, 3.0 NTU.

Literature: Russell 1961; Koste 1981.

Monostyla decipiens Murray

FIG. 2:4

Monostyla decipiens Murray, 1913a, p. 36, Pl. 15, Fig. 43.

Lecane (M.) decipiens: Wiszniewski 1953, p. 375.

Diagnosis: Head aperture dorsal and ventral margins coincident, with deep V-shaped sinuses, rounded posteriorly; two triangular acute cusps between anterior sinus and edges of lorica; no frontal spines; lateral sulci deep; toe long and slender, ¼ body length.

Total length 175 µm; dorsal plate 76-116×60-98 µm; ventral plate 90-128×50-78 µm; width anterior cusps 44 µm; toe 25-48 µm.

Distribution: Sth and Central America, Sri Lanka, Europe. Identified from Nth Qld (C.H. Fernando pers. commun.). Record unverified.

Literature: Chengalath & Fernando 1973; Koste 1978.

Monostyla elachis Harring & Myers

FIG. 2:5

Monostyla elachis Harring & Myers, 1926, p. 406, Fig. 43:1, 2.

Lecane furcata elachis: Wiszniewski 1954, p. 65.

Diagnosis: Head aperture with lightly convex dorsal margin; ventral margin with shallow median concavity, convex towards exterior angles; dorsal lorica ornamented with regular row of facets anterioiy, remainder of surface patterned (Fig. 2:5a); deep lateral sulci; toe > ¼ body length, terminating in short, acute claw.

Total length 90 µm; dorsal plate 62×62 µm; ventral plate 68×54 µm; anterior dorsal margin 40

Fig. 3. 1. *Monostyla goniata* Harring & Myers: (a) dorsal; (b) ventral. 2, *M. hamata* Stokes: (a) dorsal; (b) ventral; (c) *M. hamata victoriensis* Koste & Shiel. 3, *M. lunaris* Ehrenberg: (a) dorsal; (b) ventral; (c) another morph, ventral; (d-e) morphs of *M. lunaris perplexa* (Ahlstrom), ventral; (f-g) morphs of *M. lunaris consimilis* (Murray), ventral. Fig. 3:1, 2a-b, 3a-c, after Harring & Myers (1926); 2c, after Koste & Shiel (1980); 2d, e after Ahlstrom (1938); 3e-g, after Koste (1978). Scale lines 50 µm.

μm , ventral 50 μm ; toe 20 μm ; claw 4 μm .

Distribution: Pond littorals, U.S.A., Sri Lanka. Rare; N.T., Tas., 16.0-24.5°C, pH 6.3-7.1 DO 5.8 mg l⁻¹, 59-1020 $\mu\text{S cm}^{-1}$.

Literature: Chengalath & Fernando 1973; Koste 1978.

Monostyla furcata Murray

FIG. 2:6

Monostyla furcata Murray, 1913a, p. 358, Fig. 15:40.
Lecane (M.) furcata: Edmondson 1936, p. 215.

Diagnosis: Ventral and dorsal margins of head aperture straight; ventral plate parallel-sided behind triangular areas extending beyond dorsal anterolateral margins; toe short, stout, $\frac{1}{4}$ body length, terminating in two distinct claws, immobile, separated by V-shaped notch.

Dorsal plate 58-76x57-70 μm ; toe 21-35 μm ; claw 5-6.5 μm .

Distribution: Cosmopolitan in periphyton. Rare; N.T., Qld., Tas., Vic. 15.0-24.5°C, pH 5.3-7.9, DO 5.8-6.12 mg l⁻¹, 28-80 $\mu\text{S cm}^{-1}$.

Monostyla goniata Harring & Myers

FIG. 3:1

Monostyla goniata Harring & Myers, 1926, p. 390, Pl. 37, Figs. 5, 6.

Lecane (M.) goniata: Voigt 1957, p. 238.

Diagnosis: Lorica broadly ovate, somewhat angular posteriorly, almost pear-shaped; head aperture resembles that of *M. bulla*, i.e. shallow dorsal V-shaped sinus with median semicircular excision, very deep ventral sinus; dorsal lorica more angular than *M. bulla*, pointed posteriorly; ventral plate narrows in front of foot; posterior segments small, angular, concave terminally; first foot segment broad, indistinct, second segment larger, trapezoidal; toe very long, spindle-shaped, $\frac{1}{3}$ body length, terminating in acute conical point with median line.

Total length 200 μm , lorica length 145 μm , width 115 μm , anterior margin width 40 μm , toe 65 μm . **Distribution:** N. America, eastern Europe, shallow waters. Rare; unconfirmed report from western Vic.

Literature: Berzins 1982.

Comment: Although synonymised with *M. bulla* by various authors (e.g. Koste 1978), this taxon is immediately recognizable and separable from that species. The specific status proposed by Harring & Myers is retained here.

Monostyla hamata Stokes

FIG. 3:2a, b

Monostyla hamata Stokes, 1896, p. 21, Pl. 7, Figs 6-8.
Lecane (M.) hamata: Myers 1937, p. 4.

Diagnosis: Head aperture with narrow U-shaped sinus dorsally, ventrally with deep V-shaped sinus

having two cusps in middle of margins, rounded posteriorly; ventral plate extended anteriorly to form two acute cusps on either side of head aperture; dorsal plate with conspicuous regular faceting; transverse fold and several longitudinal folds on ventral plate.

Dorsal plate 61-88x52-66 μm ; ventral plate 77-98x40-60 μm ; toe 26-38 μm .

Distribution: Cosmopolitan in periphyton, moss pools. Common; probably pancontinental, not recorded from S. Aust. 10.0-30.7°C, pH 3.8-8.4, DO 4.8-13.0 mg l⁻¹, 23-3330 $\mu\text{S cm}^{-1}$, 4-160 NTU, alkal. 1.9-4.1 mg l⁻¹.

Comment: A variant from a Goulburn R. billabong, described as *Lecane (M.) hamata victoriensis* [Koste & Shiel 1980 (Fig. 3:2c)] has a deep trapezoid notch in the anterior ventral margin, and congruent points of anterior dorsal and ventral margins.

Literature: Shiel & Koste 1979; Green 1981; Koste 1981.

Monostyla lamellata thalera (Harring & Myers)

FIG. 6:1

Monostyla thalera Harring & Myers, 1926, p. 394, Fig. 39:3, 4.

M. lamellata thalera: Koste 1978, p. 254.

Diagnosis: Head aperture with concave, sinuate dorsal margin; ventral margin with deep, V-shaped sinus; two small anterior spines at external angles; toe long and stout, $<\frac{1}{3}$ body length, spindle shaped and enlarged near middle; claw long, stout, acutely pointed, with basal spicules and median mucus groove.

Dorsal plate 109-167x90-128 μm ; ventral plate 146-173x90-155 μm ; toe 42-82 μm ; claw to 16 μm .

Distribution: N. and S. America, Europe, N. Africa. Halophile, not found in freshwater. Rare; saline waters in S. Aust., Tas., W.A.

Comment: Described by Harring & Myers (1926) as specifically distinct from *M. lamellata*, which has a lunate anterior ventral sinus and distinctive posterior lateral triangular cusps, however intergrades have been reported in varying salinities. These variants may represent ecotypic responses to extremes in the biotope. Only the *thalera* morph has been identified from southern Australian saline waters.

Literature: Koste & Shiel 1987a.

Monostyla lunaris Ehrenberg

FIG. 3:3

Monostyla lunaris Ehrenberg, 1832, p. 127.

Lecane (M.) lunaris: Edmondson 1935, p. 302.

Diagnosis: Head aperture narrow dorsally, with V-shaped posteriorly rounded sinus; ventral margin wide, sinus deep; transverse dorsal fold at base of

anterior sinus; transverse ventral fold in front of foot; toe long and slender, $>\frac{1}{2}$ body length, with two annular constrictions; claw long, slender, acutely pointed, two minute spicules at base.

Dorsal plate $87-115 \times 70-95 \mu\text{m}$; ventral plate $96-122 \times 54-89 \mu\text{m}$; toe $42-76 \mu\text{m}$; claw $6-12 \mu\text{m}$.

Distribution: Cosmopolitan in a remarkable range of habitats: standing and flowing waters, fresh to saline, soda lakes, acid moss pools, etc. Common: pancontinental. $6.0-29.8^\circ\text{C}$, pH 3.1-8.9, DO 4.9-14.4 mg l⁻¹, 13.4-3330.0 $\mu\text{S cm}^{-1}$, 0.4-160 NTU, alkal. 2.3 mg l⁻¹.

Comment: Extremely variable eurytopic species, possibly a species-complex. Recognizable variants recorded from Australia include *M. lunaris constricta* (Murray 1913b) (Fig. 3:3f, g) from the R. Murray at Blanchetown, S.Aust. and *M. lunaris perplexa* (Ahstrom 1938) (Fig. 3:3d, e) from Victoria. *M. lunaris australis* described by Berzins (1982) from Victoria falls within the range of variation of the parent species and is here synonymized.

Literature: Koste 1978, 1981; Shiel & Koste 1979; Koste & Shiel 1983, 1986a.

Monostyla monostyla Daday

FIG. 4:1

Monostyla monostyla Daday, 1897, p. 143, Fig. 10.
Lecane (M.) monostyla: Wiszniewski 1954, p. 68.

Diagnosis: Head aperture margins straight and coincident; two small spines at external angles; long moveable curved spines hinged to lateral margin of dorsal lorica, can be rotated and swung back into lateral sulcus when animal swimming, conforming to margin of posterior lorica.

Total length (contracted) $125-153 \mu\text{m}$; dorsal plate $30-58 \times 47 \mu\text{m}$; ventral plate $62-80 \times 46-50 \mu\text{m}$; toe $25-40 \mu\text{m}$.

Distribution: Pantropical and subtropical, also in temperate latitudes in summer. Single record from L. Euramoo, Qld.

Literature: Koste 1978, Green 1981.

Monostyla obtusa Murray

FIG. 4:3

Monostyla obtusa Murray, 1913a, p. 357, Pl. 15, Fig. 37.
Lecane (M.) obtusa: Wiszniewski 1953, p. 378.

Diagnosis: Head aperture margins straight, coincident; two minute frontal spines at external angles; lateral sulci shallow, indistinct; toe $\frac{1}{2}$ body length, slightly enlarged distally; claw long, acutely pointed, with median dividing line, but unseparated; two basal spicules.

Contracted length to $115 \mu\text{m}$; dorsal plate $53-78 \times 45-73 \mu\text{m}$; ventral plate $62-80 \times 45-58 \mu\text{m}$; anterior margin width to $58 \mu\text{m}$; toe $22-40 \mu\text{m}$; claw $6-13 \mu\text{m}$.

Distribution: Cosmopolitan, pH tolerant, eurytopic. Known only from L. Euramoo, Qld., and Yackandandah Creek, Vic.

Literature: Koste 1978; Green 1981.

Monostyla opias Hanning & Myers

FIG. 4:2

Monostyla opias Hanning & Myers, 1926, p. 411, PL 45, Figs 5, 6.

Lecane (M.) opias: Voigt 1957, p. 229.

Diagnosis: Head aperture margins coincident, straight, with two small acute frontal spines; transverse ventral fold in front of foot; toe long, $>\frac{1}{4}$ body length, tapering gradually to bristle-like point:

Contracted length $95-100 \mu\text{m}$; dorsal plate $59-66 \times 54-61 \mu\text{m}$; ventral plate $67-99 \times 42-55 \mu\text{m}$; toe $26-30 \mu\text{m}$.

Distribution: Europe, Americas, between Sphagnum. Aufwuchs. Acidophil. Single record Yarra R., McMahons Creek, Vic., needs confirmation.

Literature: Koste 1978; Berzins 1982.

Monostyla pyriformis Daday

FIG. 4:4

Monostyla pyriformis Daday, 1905, p. 330.

Lecane (M.) pyriformis: Edmondson 1936, p. 214.

Diagnosis: Anterior margins coincident, medially straight or weakly convex, strongly rounded at lateral rims; rudimentary lateral sulci; toes variable, generally dagger-like.

Dorsal plate $51-67 \times 40-60 \mu\text{m}$; ventral plate $53-70 \times 39-49 \mu\text{m}$; toes $22-36 \mu\text{m}$ [Daday (1905) gave toe length of $57 \mu\text{m}$].

Distribution: Cosmopolitan in inundation zones, periphyton, moss, margins of standing and flowing waters. Rare: N.S.W., N.T., Qld., Vic. $14.7-28.5^\circ\text{C}$, pH 5.4-7.1, DO 4.1-6.2 mg l⁻¹, 23-240 $\mu\text{S cm}^{-1}$, 5 NTU, alkal. 2.7 mg l⁻¹.

Literature: Green 1981; Koste 1981; Berzins 1982.

Monostyla quadridentata Ehrenberg

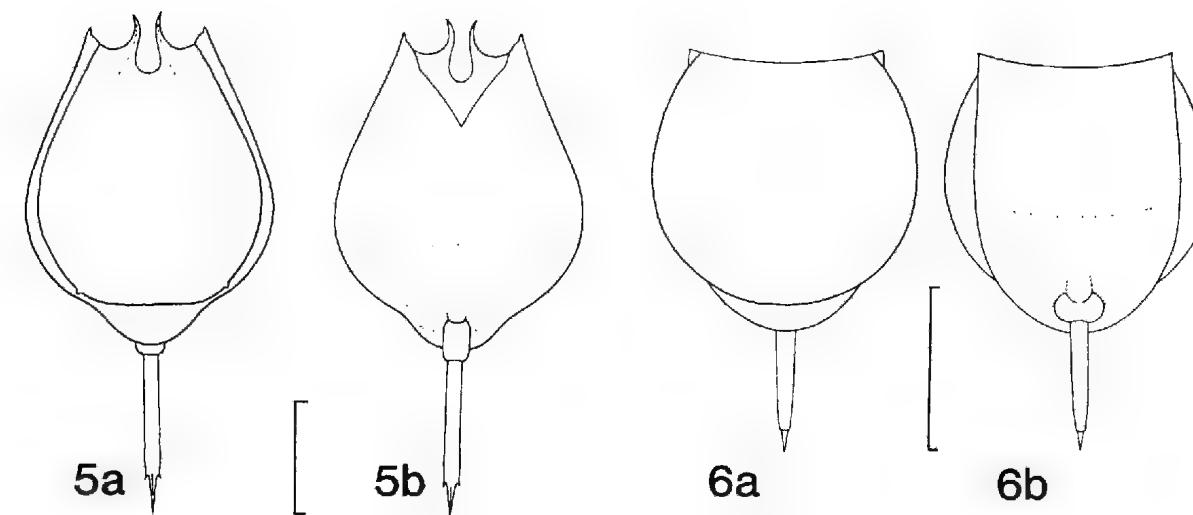
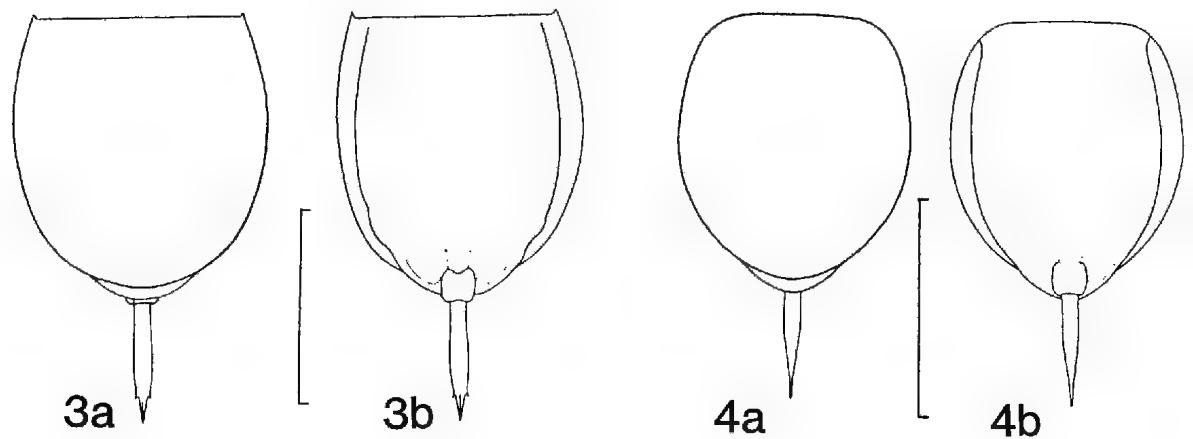
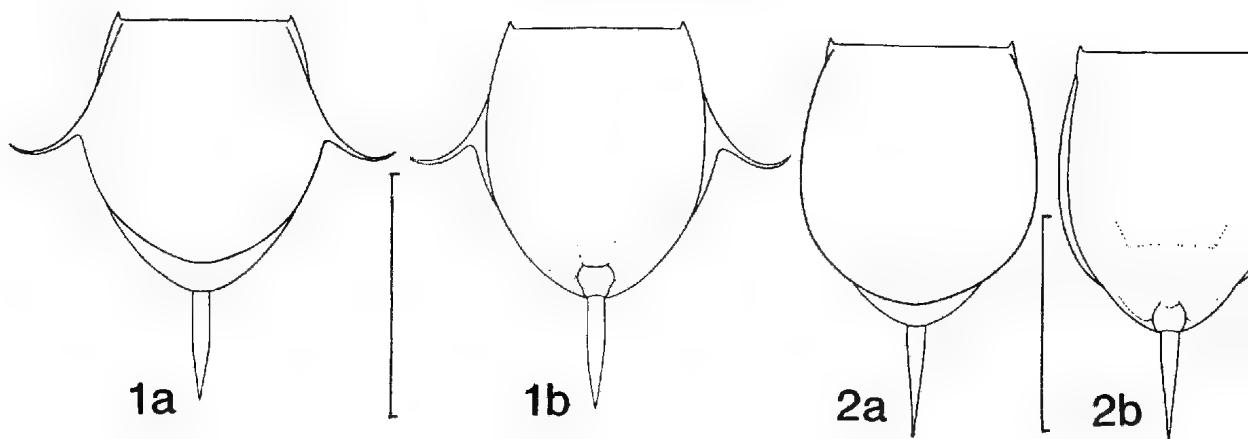
FIG. 4:5

Monostyla quadridentata Ehrenberg, 1832, p. 130.

Lecane (M.) quadridentata: Edmondson 1935, p. 302.

Diagnosis: Anterior dorsal margin with pyriform median sinus flanked by two long outcurved and decurved spines (which can be crossed in strongly contracted individuals); ventral plate with deep, sharply pointed V-shaped sinus; two minute frontal spines present; dorsal plate with two ribs originating on anterior spines; toe long, $\frac{1}{2}$ body length, with indistinct annular constriction near distal end; claw long, slender with two basal spicules.

Dorsal plate $105-106 \times 90-125 \mu\text{m}$; ventral plate $130-170 \times 90-118 \mu\text{m}$; toes $45-90 \mu\text{m}$; claw $14-20 \mu\text{m}$.



Distribution: Cosmopolitan, warm-stenotherm, between macrophytes in littoral or fresh and slightly brackish waters. Rare: N.T., Qld., Tas., Vic., W.A. (Kimberley). 12.0-16.0 °C, pH 10.8.8, to 3820 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978.

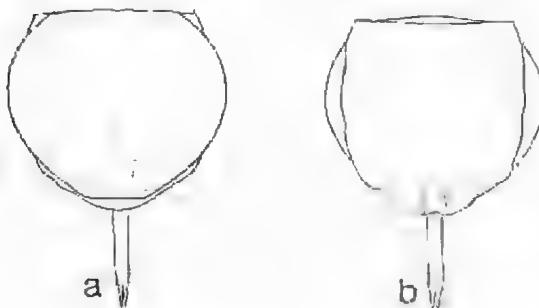


Fig. 5. *Monostyla rugosa* Herring: (a) dorsal; (b) ventral. Scale line 50 μm . After Herring & Myers (1926).

Monostyla rugosa Herring

FIG. 5

Monostyla rugosa Herring, 1914, p. 548, Fig. 24:4-6.
Diagnosis: Head aperture margins nearly coincident, ventral straight, dorsal lightly concave; dorsal plate wider than long, anterior margin narrower than that of ventral plate; dorsal wrinkles deep and irregular; ventral ornamentation constant as shown (Fig. 5b); lateral sulci shallow, indistinct; toe approx. $\frac{1}{4}$ total length terminating in long double claw.

Total length 84 μm , lorica length 57 μm , dorsal plate 54x62 μm , ventral plate width 45 μm , anterior margin dorsal plate 34 μm , ventral plate margin 45 μm , toe 21 μm , claw 6 μm .

Distribution: Panama, U.S.S.R. First Australian record Ryan's #1 billabong at Albury, N.S.W. 12.9.88, in *Eleocharis* reedbed. 15.8 °C, pH 7.16, DO 7.12 mg l⁻¹, 82.2 $\mu\text{S cm}^{-1}$.

Monostyla scutata Herring & Myers

FIG. 4:6

Monostyla scutata Herring & Myers, 1926, p. 401, Pl. 40, Figs. 1, 2.

Lecane (*M.*) *scutata*: Wiśniewski 1954, p. 378.

Diagnosis: Head aperture margins coincident, lightly concave; sharp corners but no anterior spines; lateral sulci shallow, indistinct; transverse fold of ventral plate; toe long, stout, $\frac{1}{3}$ total length, parallel-sided then tapering to slender acute claw.

Fig. 4. 1. *Monostyla monostyla* Daday: (a) dorsal; (b) ventral. 2. *M. opus* Herring & Myers: (a) dorsal; (b) ventral. 3. *M. obtusa* Murray: (a) dorsal; (b) ventral. 4. *M. pyriformis* Daday: (a) dorsal; (b) ventral. 5. *M. quadridentata* Ehrenberg: (a) dorsal; (b) ventral. 6. *M. scutata* Herring & Myers: (a) dorsal; (b) ventral. Fig. 4: 1-6, after Herring & Myers (1926). Scale lines 50 μm .

Dorsal plate 62-78x63-72 μm ; ventral plate 68-80x50-72 μm ; toe 26-34 μm ; claw 5-7 μm .

Distribution: Cosmopolitan acidophil, in Sphagnum. Rare: N.L., S. Aust., Tas. 11.0-28.5 °C, pH 5.4-7.8, DO 6.2 mg l⁻¹, alkal. 2.7 mg l⁻¹.

Literature: Koste 1981; Koste & Shiel 1986a.

Monostyla sinuata (Hauer)

FIG. 6:1

Lecane sinuata Hauer, 1938, p. 545, Fig. 67.

L. hamata var. *sinuata*: Koste 1978, p. 239.

Diagnosis: Head aperture conspicuously small, both margins with V-shaped sinuses, but not coincident: dorsal with convex sides, ventral very narrow, twice as deep as dorsal, with straight sides; minute frontal spine on either side of head aperture; dorsal plate smooth, rounded posteriorly; ventral plate same width as dorsal anteriorly, much narrower medially, has transverse fold, longitudinal lines as figured; posterior plate extends beyond dorsal margin; toe $\frac{1}{3}$ body length; no claw.

Dorsal plate 74-76x53-55 μm ; ventral plate 80-82x41-46 μm ; toe 28 μm .

Distribution: Sumatra, India. Rare: Tas. 18.0-21.5 °C, pH 6.8-7.7, 92.1-3330 $\mu\text{S cm}^{-1}$.

Comment: Described from a single specimen, *M. sinuata* was noted by Hauer (1938) to resemble *M. hamata* and was so synonymised by Koste (1978). The distinctive head aperture and lack of ornamentation of the dorsal plate renders the species immediately recognisable as distinct from *M. hamata*. The specific determination is retained here.

Literature: Wulfert 1966; Koste & Shiel 1986a.

Monostyla stenorosi Meissner

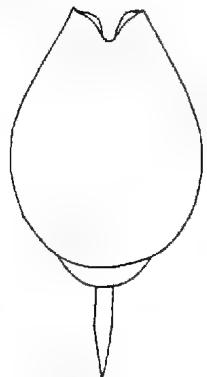
FIG. 6:2

Monostyla stenorosi Meissner, 1908, p. 22, Fig. 1:8.
Lecane (*M.*) *stenorosi*: Wiśniewski 1953, p. 378.

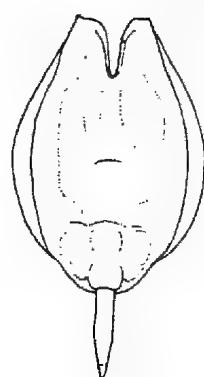
Diagnosis: Head aperture dorsally straight, ventrally with shallow rounded sinus with strongly convex sides; two short stout, incurved hooklike frontal spines; lateral sulci very deep, particularly in anterior half, with characteristic constriction in ventral plate; toe long, stout $\frac{1}{3}$ body length, slightly enlarged in middle; claw short, stout, acutely pointed, with two basal spicules.

Dorsal plate 90-117x83-100 μm ; ventral plate 98-122x85-103 μm ; toe 40-51 μm ; claw 10-11 μm .

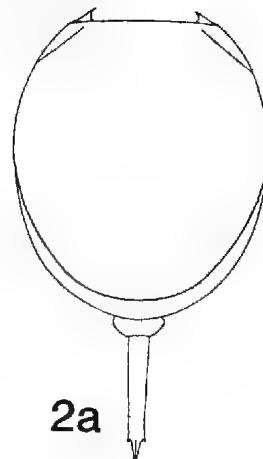
Distribution: Widespread, but isolated. Abundant in algal mats in ephemeral pools, in periphyton and littoral of larger waters. Warm stenotherm. Rare.



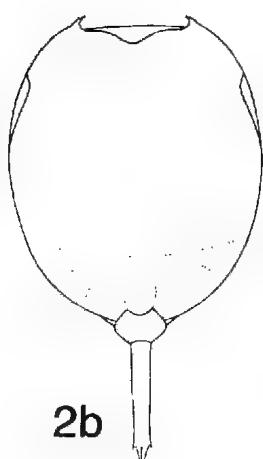
1a



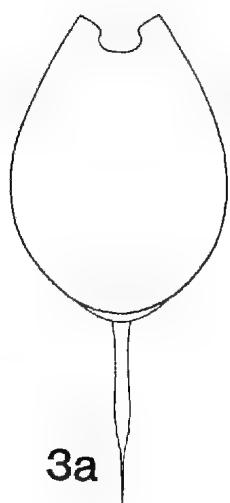
1b



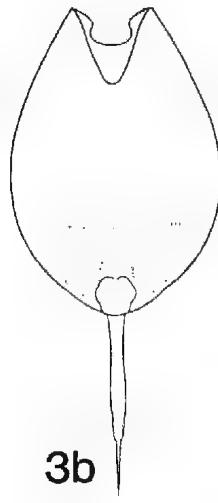
2a



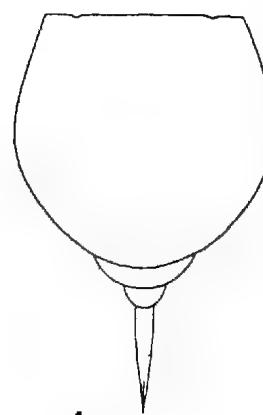
2b



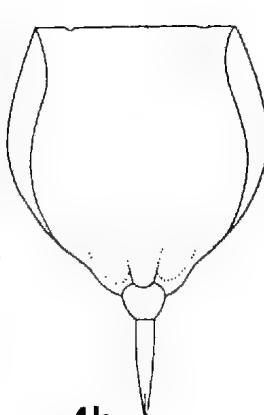
3a



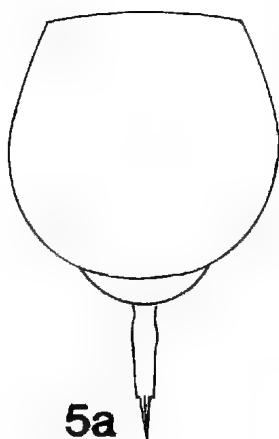
3b



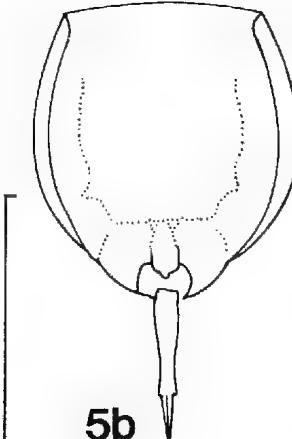
4a



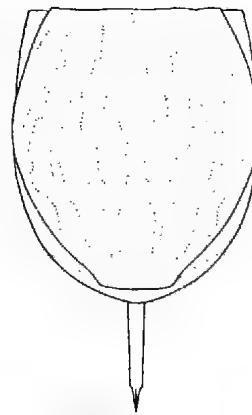
4b



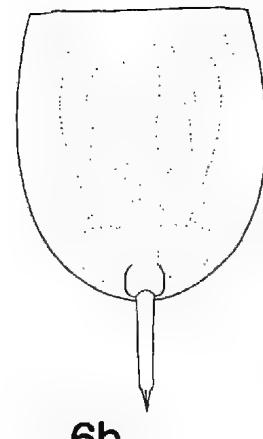
5a



5b



6a



6b

N.S.W., Qld, 13.5–20.0°C, pH 7.5–8.1, DO 7.0–9.0 mg l⁻¹, 400–575 µS cm⁻¹, 50–160 NTU.
Literature: Shiel & Koste 1979.

Monostyla styrax Harring & Myers
 FIG. 6:3.

Monostyla styrax Harring & Myers, 1926, p. 389–90, Pl. 37, Figs 3, 4.
Lecane bulla styrax: Myers 1937, p. 2.

Diagnosis: Head aperture narrow, dorsally with wide median elliptic notch, ventrally with deep straight-sided sinus, rounded posteriorly; lateral sulci very deep; toe long, slender, > 1/3 total length, increasing slightly in width in distal half, tapering to blunt point; claw extremely long, slender, acutely pointed. Can be distinguished from *M. bulla* by claw alone, however anterior margin, foot and toe also differ significantly.

Dorsal plate 124×90 µm; ventral plate 128×90 µm; toe 78 µm; claw 24 µm.

Distribution: North America, N.Z.; Single record from Qld.

Literature: Russell 1961; Koste 1978; Shiel & Koste 1979.

Monostyla subulata perpusilla (Hauer)
 FIG. 6:5

Monostyla perpusilla Hauer, 1929, p. 156, Fig. 14
Lecane (M.) perpusilla: Wiszniewski 1953, p. 378;
L. subulata perpusilla: Koste 1962, p. 113

Diagnosis: Ventral plate bilaterally constricted just under anterior margin; anterior margins lightly convex, coincident; dorsal and ventral surfaces may have indistinct folds; toe long, with distinct constriction in posterior third, > 1/3 body length; claw long, acutely pointed. Large red eyespot, irregularly formed, seen in fresh material.

Total length 69–72 µm; length, dorsal 44–50 µm, ventral 55 µm; width, dorsal to 55 µm, ventral 41–48 µm; anterior margin width 41 µm; toe 19–29 µm; claw 10–11 µm.

Distribution: Sphagnum, capillary water of beach sands. Single record from Yarra R. near Ivanhoe, Vic. needs verification.

Comment: The typical form, *M. subulata* Harring & Myers (1926) (Fig. 5:4) has not been recorded from Australia. It can be distinguished from the above taxon by its larger size and relatively shorter toe and claw. Total length (contracted) 87–100 µm; dorsal length 53–64 µm, width 51–65 µm; ventral length 59–68 µm, width 46–55 µm; anterior margin 39–50 µm; toe 16–27 µm; claw 8–10 µm.

Literature: Koste 1978; Berzins 1982.

Monostyla tethis Harring & Myers

FIG. 6:6

Monostyla tethis Harring & Myers, 1926, p. 405, Pl. 38, Figs 1, 2.

Lecane (M.) tethis: Wiszniewski 1954, p. 71.

L. furcata var. *tethis* (sic): Koste 1978, p. 242, FIG. 81:7a, b.

Diagnosis: Head aperture with coincident straight dorsal and ventral margins; regular facetting of dorsal plate, with each facet bounded by double longitudinal lines; ventral plate also with longitudinal markings; transverse fold in front of foot, two small semicircular folds; toe long, 1/4 body length, straight with slight taper; claw long, slender.

Total length 100 µm; dorsal plate 70×62 µm; ventral plate 74×62 µm; anterior margin width, dorsal, 42 µm, ventral 53 µm; toe 24 µm; claw 6 µm.

Distribution: Rare in N. America, Central Europe. Single record from L. Euramoo, Qld.

Comment: Synonymised with *M. furcata* by Koste (1978). *M. tethis* lacks the distinctive divided claw of *M. furcata*, and its lorica morphology only superficially resembles that species, which does not have the dorsal and ventral patterning as described. *M. tethis* is of restricted occurrence, probably of precise habitat requirements.

Literature: Koste 1978; Green 1981.

Monostyla unguitata Fadeev

FIG. 7:2

Monostyla unguitata Fadeev, 1925, p. 21, Fig. 1:7.

Lecane (M.) unguitata: Wiszniewski 1954, p. 72.

Diagnosis: Head aperture dorsal margin straight, ventral with median U-shaped notch in broad, shallow lunate sinus (Fig. 6:2b); dorsal plate narrower and shorter than ventral; ventral obliquely truncated on end; small front corner spines point inwards as in *M. stenoosi*; toe parallel-sided, slightly swollen distally; claw long, separated or fused.

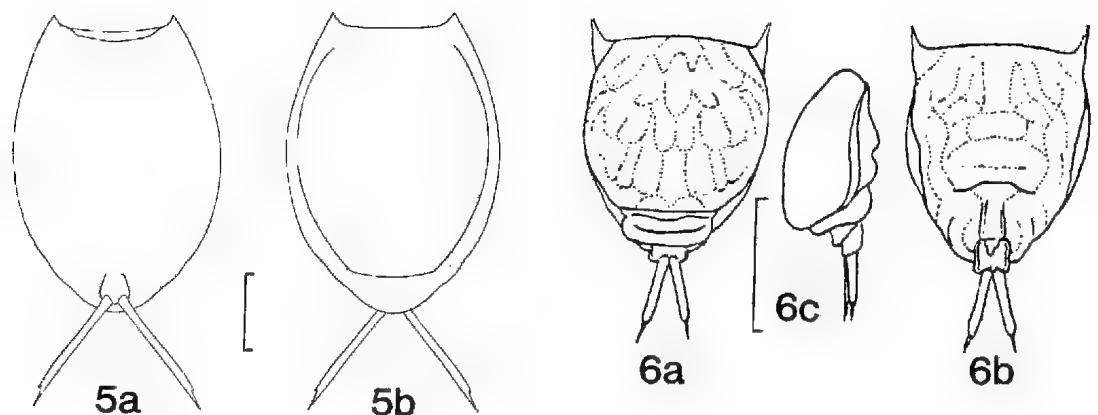
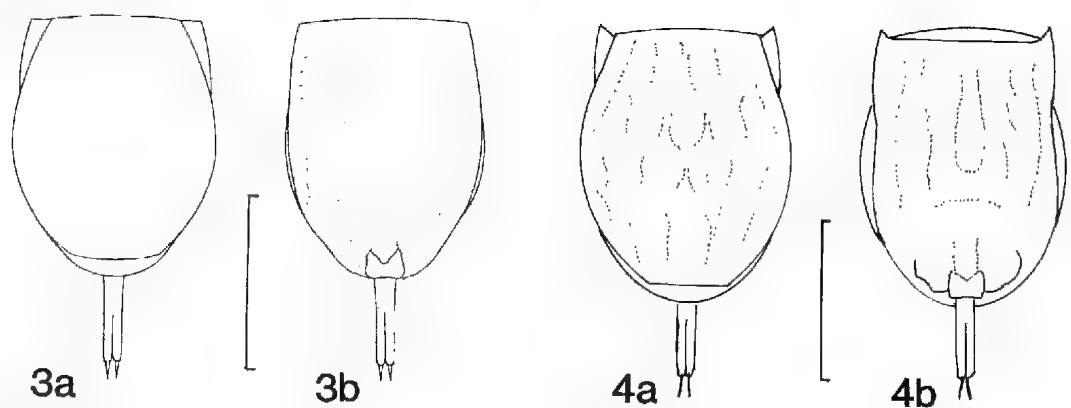
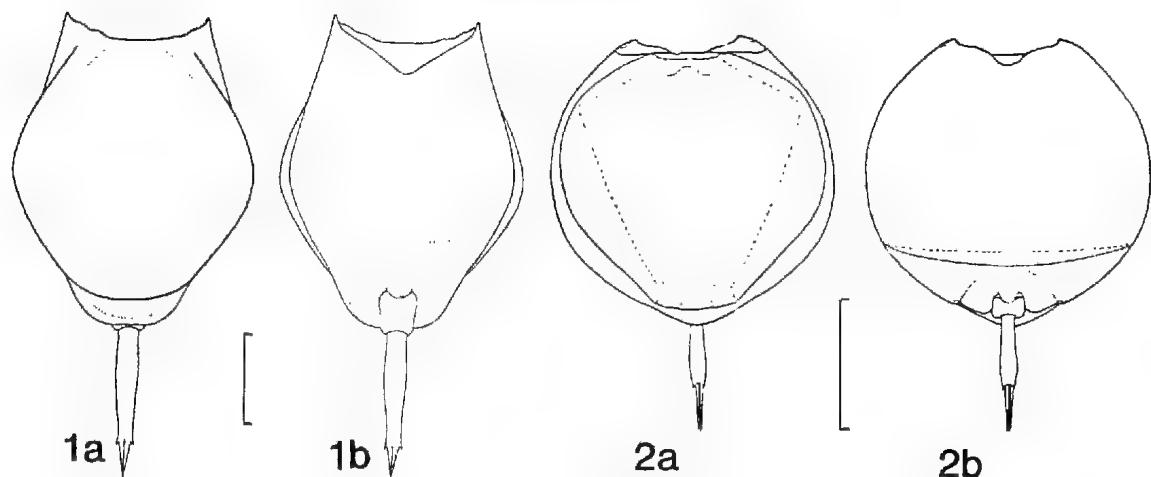
Dorsal plate 83–110×86–92 µm, ventral plate 93–122×93–95 µm; toe 37–44 µm; claw to 15 µm.

Distribution: Rare in East Europe, N. America, Asia, Sri Lanka. Billabongs at Albury, N.S.W., and Jabiluka, N.T. 25.0–31.0°C, pH 6.2–6.3, DO 3.2–10.3 mg l⁻¹, 48–140 µS cm⁻¹.

Comment: A single ecotypic variant was identified from a billabong of the Coleman R., Cape York, Qld, lacking the characteristic anterior projections, and slightly smaller in some dimensions.

Measurements: Dorsal plate 104×72 µm; ventral plate 104×83 µm; toe 28 µm; claw 12 µm (Shiel & Koste 1985).

Fig. 6. 1, *Monostyla sinuata* Hauer: (a) dorsal; (b) ventral. 2, *M. stenoosi* Meissner: (a) dorsal; (b) ventral. 3, *M. styrax* Harring & Myers: (a) dorsal; (b) ventral. 4, *M. subulata* Harring & Myers: (a) dorsal; (b) ventral. 5, *M. subulata perpusilla* Hauer: (a) ventral; (b) dorsal. 6, *M. tethis* Harring & Myers: (a) dorsal; (b) ventral. FIG. 6: 1–3, 5, after Harring & Myers (1926); 4, after Hauer (1929). Scale lines 50 µm.



Literature: Hauer 1938; Wulff 1966; Koste 1978.

Of fourteen taxa of lecanids with part fusion of the toe listed by Koste (1978), only two variants of a single species, *Hemimonostyla inopinata* (Fig. 7:3, 4) are known from Australia. No key is provided for the genus. For details refer to Koste (1978).

Hemimonostyla inopinata (Harring & Myers)
FIG. 7:3

Lecane inopinata Harring & Myers, 1926, p. 274, Fig. 12:5, 6.

Diagnosis: Head aperture margins coincident; slightly convex; no frontal spines; dorsal plate smooth, narrower than ventral plate anteriorly, slightly truncate posteriorly; ventral plate with two transverse and several longitudinal ridges; lateral sulci deep; toes long, slender, $\frac{1}{4}$ total length, fused for distal $\frac{2}{3}$ of their length; terminate in distinct claw.

Dorsal plate $56\text{-}75 \times 54\text{-}62 \mu\text{m}$; ventral plate $59\text{-}80 \times 40\text{-}58 \mu\text{m}$; toe $21\text{-}31 \mu\text{m}$; claws $3\text{-}5 \mu\text{m}$.

Distribution: Probably cosmopolitan - subtropical, warm stenotherm. Single record from Wyangala Dam, NSW. A record of *H. inopinata sympoda* (Hauer 1929) (Fig. 7:4) from Cairns, Qld (C.H. Fernando pers. comm.) is unverified. Also a warm stenotherm, possibly pantropical, *sympoda* is distinguished from the nominate species by the bilaterally constricted anterior ventral plate, presence of triangular cusps at the anterior corners, and variable lineation of dorsal and ventral plates (see Koste 1978).

Dorsal plate $55\text{-}83 \times 49\text{-}73 \mu\text{m}$; ventral plate $58\text{-}87 \times 48\text{-}68 \mu\text{m}$; claws $3\text{-}9 \mu\text{m}$.

Key to species of the genus *Lecane*

1. Lorica with acute cusps or rounded projections at anterior external angles 3
Lorica without spines or projections at anterior angles 2
- 2(1). Toes with claws or pseudoclaws 8
Toes without claws or pseudoclaws 4
- 3(1). Toes with claws or pseudoclaws 26
Toes without claws or pseudoclaws 17
- 4(2). Dorsal plate at least as long or longer than ventral plate *L. clara* (Bryce)
Dorsal plate noticeably shorter than ventral plate 5
- 5(4). Anterior margin almost straight or lightly convex 16
- 6(5). Anterior margin (dorsal) with regular undulating lines *L. nodosa* Hauer
- 7(6). Toes $\frac{1}{2}$ body length; dorsal and ventral surfaces with complex pattern (Fig. 16:3) *L. venusta* Harring & Myers
- 8(2). Toes $\frac{1}{4}\text{-}\frac{1}{3}$ body length; dorsal surface smooth or sparsely lined, ventral plate with single transverse fold and some longitudinal folds; 7
- 9(8). Lorica wider than long; 2nd foot segment projects well beyond posterior margin *L. hornemannii* (Ehrenberg)
- 10(7). Lorica longer than wide; 2nd foot segment beneath lorica margin *L. nana* (Murray)
- 11(9). Lorica $180\text{-}200 \mu\text{m}$; toes $>70 \mu\text{m}$ 9
Lorica $<180 \mu\text{m}$; toes $<50 \mu\text{m}$ 10
- 12(10). Barrel-shaped lorica (L:W ratio 1.25); broad footplate without marked constriction of lorica margin *L. grandis* (Murray)
- 13(11). Lorica more elongate (L:W ratio 1.5), with anterior constriction behind head aperture and marked constriction of margins at footplate *L. boorali* Koste & Shiel
- 14(12). Toes long ($\frac{1}{4}\text{-}\frac{1}{2}$ body length) clearly visible beyond footplate 11
Toes remarkably short ($<1/10$ body length) barely protruding beyond footplate in dorsal view *L. pamila* Rousselet
- 15(10). Lorica elongated (L:W ratio 1.8) *L. inermis* (Bryce)
- 16(11). Lorica broadly ovate (L:W <1.5) 12
- 17(12). Dorsal and ventral plates distinctly patterned 15
Dorsal plates smooth, ventral with single transverse fold or light ornamentation 13
- 18(13). Claws short (claw:toe ratio <3.0) 14
Claws long (ratio >3.0) *L. tenuiseta* Harring
- 19(14). Ventral plate with posterolateral corners anterior to footplate producing rectangular appearance *L. rufneri* Hauer
Ventral plate posterior margins smoothly curved, without corners. *L. formosa* Harring & Myers
- 20(15). Claws short ($<10 \mu\text{m}$) 16
Claws long (13-18 μm) *L. doryssa* Harring
- 21(16). Dorsal plate subcircular; footplate projects beyond dorsal plate to cover 2nd foot segment *L. pusilla* Harring
Dorsal plate parallel-sided; 2nd foot segment projects beyond footplate *L. subtilis* Harring & Myers
- 22(17). Caudal margin of lorica broadly truncate or rounded 18
Caudal margin tapering to point, bilaterally constricted tongue or 'fishtail' 25
- 23(18). Caudal margin straight, with obtuse angled corners 19

Fig. 7, 1, *Monostyla lamellata thaleni* (Harring & Myers). (a) dorsal; (b) ventral. 2, *M. unguitata* Fadeev: (a) dorsal; (b) ventral. 3, *Hemimonostyla inopinata* (Harring & Myers): (a) dorsal; (b) ventral. 4, *H. inopinata sympoda* Hauer: (a) dorsal; (b) ventral. 5, *Lecane acronycha* Harring & Myers: (a) ventral; (b) dorsal. 6, *L. aculeata* (Jakubski): (a) dorsal; (b) ventral. Fig. 7: 1, 3-5, after Harring & Myers (1926); 2, after Hauer (1938); 6, after Wulff (1965). Scale lines 50 μm .

- Caudal margin smoothly oval/elliptical. 20
- 19(18). Toes <30 µm, short and stout. *L. brachydactyla* (Stenoos)
Ibc >30 µm, thin, with finer taper. *L. iudicola* Harring & Myers
- 20(18). Second foot segment protrudes at least $\frac{1}{2}$ its length beyond caudal margin. 21
Second foot segment not protruding. 22
- 21(20). Toes <50 µm; ventral lorica >150 µm. *L. pectica* Harring & Myers
Toes <40 µm; lorica <100 µm. *L. rhytida* Harring & Myers
- 22(20). Lorica surfaces smooth. 23
Surfaces (particularly dorsal) clearly ornamented. *L. signifera* (Jennings)
- 23(22). Frontal margins straight or slightly concave; caudal margin smoothly rounded. 24
Margins deep V-shaped sinuses; caudal margin lobate. *L. herzigi* Koste & Shiel
- 24(23). Lorica elongated, 200 µm; toes 75 µm. *L. pyrrha* Harring & Myers
Lorica <150µm; toes <20µm. *L. levistyla* (Olofsson)
- 25(17). Posterior lorica tapers to point. *L. ludwigi* (Eckstein)
Posterior lorica a bilaterally constricted blunt tongue, or 'fishtail'. *L. ohioensis* (Merrick)
- 26(3). Frontal corners of lorica with acute spines or cusps. 27
Frontal corner projections rounded rather than acute. *L. papuana* (Murray)
- 27(26). Claws with knoblike swelling. *L. hastata* (Murray)
Claws without swelling. 28
- 28(27). Ventral plate with elongated footplate. *L. leontina* (Turner)
Ventral caudal margin symmetrically rounded. 29
- 29(28). Lorica ventral margin projects beyond dorsal. *L. elsa* Hauer
Margins coincident or dorsal projects beyond ventral. 30
- 30(29). Dorsal anterior margin straight or lightly convex. 34
Dorsal anterior margin concave. 31
- 31(30). Head aperture margins coincident V-shaped sinuses. 32
Both margins broad lunate sinuses. 33
- 32(31). Smooth or weakly ornamented lorica; head aperture margins smooth. *L. curvicornis* (Murray)
Both surfaces distinctly ornamented; head aperture margin undulate. *L. nitida* (Murray)
- 33(31). Dorsal surface unornamented; no noticeable constriction of posterolateral margins at footplate. *L. luna* (Muller)
Dorsal surface stippled; footplate elongated, with distinct bilateral constriction of posterolateral margins. *L. spenceri* (Shephard)
- 34(30). Dorsal margin straight between cusps, ventral margin coincident or lightly concave. 35
Dorsal margin convex between cusps, ventral margin coincident, straight or concave. 38
- 35(34). Distal foot segment not visible beyond lorica margin. 36
Distal foot segment visible beyond lorica margin. *L. mitu* (Murray)
- 36(35). Ventral margin concave; dorsal plate smaller than ventral; toes >60 µm long. 37
Margins coincident; dorsal plate larger than ventral; toes <60 µm long. *L. tasmaniensis* Koste & Shiel
- 37(36). Claws short (claw:toe ratio >5). *L. acronycha* (Jakubskii)
Claws long (ratio <3.5). *L. unguilata* (Gosse)
- 38(34). Last foot segment visible beyond dorsal margin. 41
Last foot segment not visible beyond margin. 39
- 39(38). Head aperture margins coincident, convex; lorica not noticeably elongated. 40
Dorsal margin convex, ventral concave; lorica elongated. *L. glypta* Harring & Myers
- 40(39). Lorica <80 µm long; ventral plate constricted anteriorly; small semicircular footplate projects slightly beyond posterior lorica. *L. flexilis* (Gosse)
Lorica >100 µm long; ventral plate not constricted; footplate broad, extends well beyond posterior margin of dorsal plate. *L. aspasia* Myers
- 41(38). Ventral plate strongly constricted in 'hip' region. *L. crepidu* Harring
Ventral plate not constricted. 42
- 42(41). Dorsal plate covers all ventral plate and footplate. *L. mylaeis* Harring & Myers
Footplate visible posterior to dorsal plate. 43
- 43(42). Cusps large, outer margins convex, pointing outwards. *L. aculeata* (Jakubskii)
Cusp small, outer margins concave, point ahead or inwards. 44
- 44(43). Toe points short with distinct step on inside distinguishing claw. *L. stichaca* Harring
Toe points elongated, claws indistinct. *L. halicysta* Harring & Myers

Lecane acronycha Harring & Myers

FIG. 7:5

Lecane acronycha Harring & Myers, 1926, p. 322, Pl. 8.
Figs. 3, 4.

Diagnosis: Dorsal anterior margin straight, ventral slightly concave, with two triangular cusps at external angles; unmarked dorsal plate not reaching margin of ventral plate; transverse fold of ventral

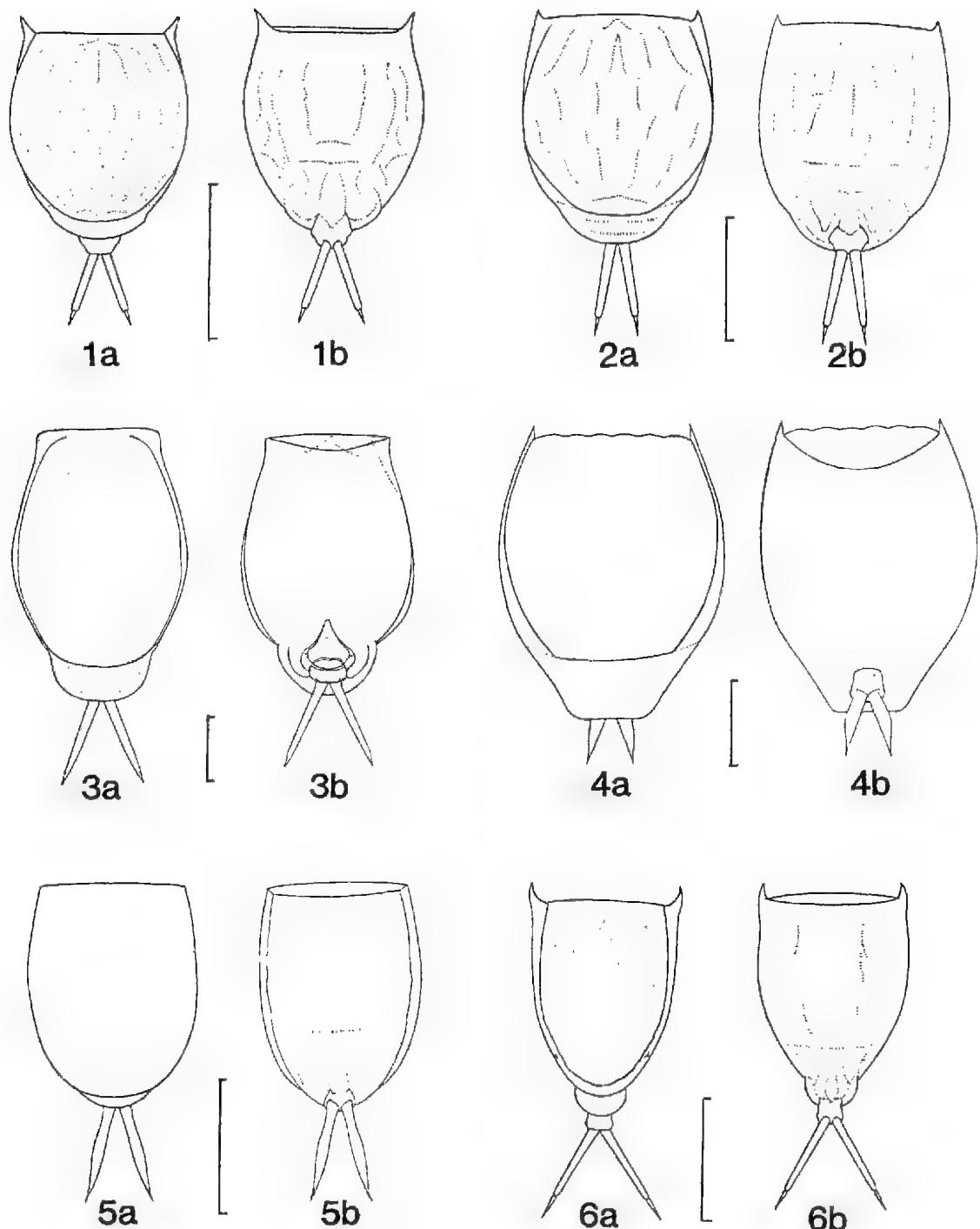
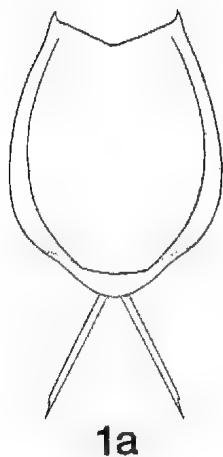
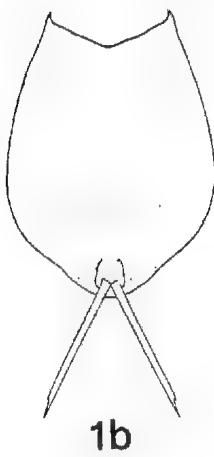


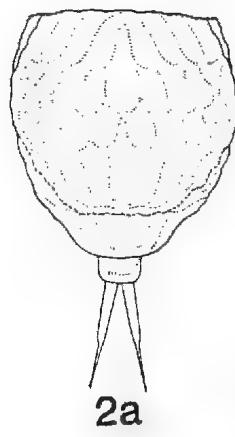
Fig. 8. 1, *Lecane aculeata arcula* (Harring): (a) dorsal; (b) ventral. 2, *L. aspasia* Myers: (a) dorsal; (b) ventral. 3, *L. boorali* Koste & Shiel: (a) dorsal; (b) ventral. 4, *L. brachydactyla* (Stenoos): (a) dorsal; (b) ventral. 5, *L. clara* (Bryce): (a) dorsal; (b) ventral. 6, *L. crepida* Herring: (a) dorsal; (b) ventral. Fig. 8: 1, 2, 4–6, after Harring & Myers (1926); 3, after Koste et al. (1983). Scale lines 50 μm .



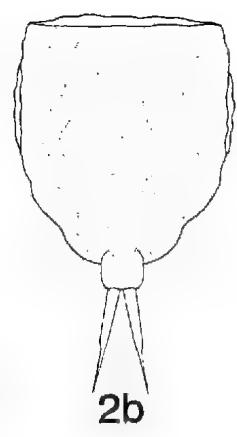
1a



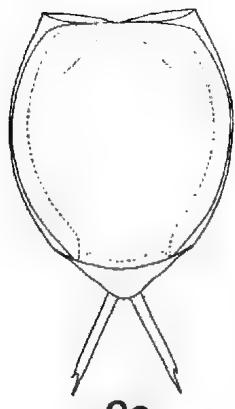
1b



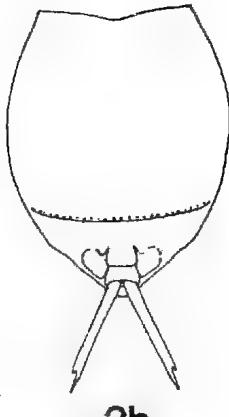
2a



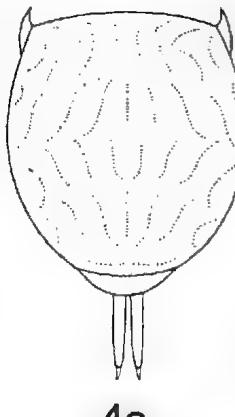
2b



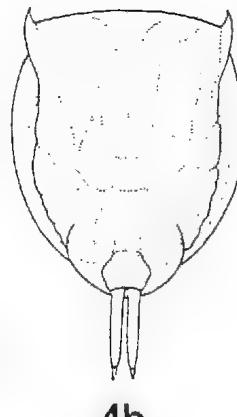
3a



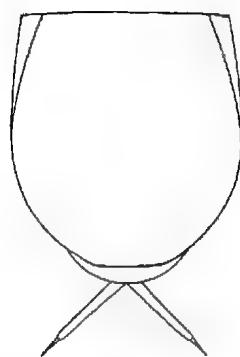
3b



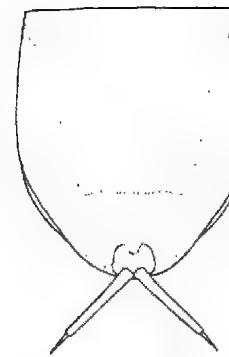
4a



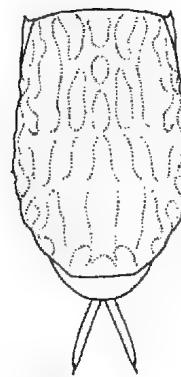
4b



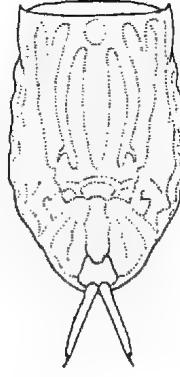
5a



5b



6a



6b

plate anterior to foot; slight indentation of posterolateral margins at footplate; toes long ($>\frac{1}{2}$ body length) with slight distal bulge; claw short, with small basal spicule.

Total length to 290 μm ; dorsal plate 111-162 \times to 136 μm ; ventral plate 125-182 \times 95-113 μm ; toes 60-102 μm ; claw 10-12 μm .

Distribution: N. America, Asia. Acidophil. Two Australian records: billabong, Jabiluka, N.T., river at Kinglake West, Vic. 25.0°C, pH 6.2, DO 3.0 mg l⁻¹, 48 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978, 1981; Berzins 1982.

Lecane aculeata (Jakubski)

FIG. 7:6

Distyla aculeata Jakubski, 1912, p.543, Figs 3,-3.

Diagnosis: Resembles *L. flexilis* (Fig. 8:4), but can readily be distinguished from it by oblique, outwardly directed frontal cusps, narrower lorica, second foot segment visible at posterior end, straight toe and bilaterally constricted needle-like claws. Dorsal plate usually truncated, with two transverse pleats beneath (Fig. 7:6a).

Dorsal plate 62-67 \times 45-55 μm ; ventral plate 73-87 \times 46-52 μm ; toe 22-28 μm ; claw 5-7 μm .

Distribution: Warm stenotherm in subtropical and tropical vegetated waters, particularly ricefields. Rare: Wyangala, N.S.W., Jabiluka, N.T., Qld, southeast S.Aust., Vic. 24.0-27.0°C, pH 6.3-7.4, DO 5.1-7.5 mg l⁻¹, 42-245 $\mu\text{S cm}^{-1}$, 0.5-15.0 NTU.

Comment: A subspecies, *Lecane aculeata arcula* (Harring) (Fig. 8:1), recorded from Magela Creek, N.T., and Gippsland, Vic. Similar lorica ornamentation, but outline more circular, particularly posterior margin of dorsal plate; transverse pleats posterior to dorsal plate lacking; frontal cusps reflexed upwards; overall dimensions smaller:

Dorsal plate 57-63 \times 49-56 μm ; ventral plate 67-78 \times 44-51 μm ; toe 22-27 μm ; claw 4-6 μm .

Literature: Koste 1978, 1981; Berzins 1982.

Lecane aspasia Myers

FIG. 8:2

Lecane aspasia Myers, 1917, p.476 Pl. 40, Figs 6-8.

Diagnosis: Lorica broad, nearly parallel-sided anteriorly, posteriorly rounded; head aperture margins coincident, slightly convex; two small cusps at external angles; posterior segment projects

beyond dorsal plate; toes $>\frac{1}{4}$ body length, straight, tapering; claw long, pointed.

Total length 132 μm ; dorsal plate 82 \times 75 μm ; ventral plate 94 \times 75 μm ; head aperture width 63 μm ; toes 30 μm ; claw 8 μm .

Distribution: California. Single record from Victoria needs verification.

Literature: Berzins 1982.

Lecane hourali Koste & Shiel

FIG. 8:3

Lecane hourali Koste & Shiel, 1983, pp. 14-15, Figs 6-8.

Diagnosis: Head aperture margins not coincident, dorsal straight; ventral concave, occasionally with median V-shaped groove; no cusps at external angles; dorsal plate narrower, shorter than ventral; characteristic triangular depressed foot cavity bounded by raised cuticular ridge (Fig. 8:3b); elongated foot plate deposited from body; toes with laterally opposed claws.

Total length 260 μm ; dorsal plate 180 \times 120 μm ; ventral 200 \times 132 μm ; anterior margin width 100 μm ; toes 82 μm ; claw 10 μm .

Distribution: Endemic; recorded only from a pool near Meekatharra, W.A. pH 8.6, 68 $\mu\text{S cm}^{-1}$.

Lecane brachydactyla (Stenoos)

FIG. 8:4

Cathypna brachydactyla Stenoos, 1898, p.160, Pl. 2, Fig. 20.

Lecane brachydactyla: Harring 1913, p.60.

Diagnosis: Head aperture dorsal margin slightly undulate with prominent lateral cusps; ventral margin with median concavity; lorica dorso-ventrally compressed, no markings; footplate prominent, trapezoidal; toes short, straight on inner edges, with long conical points.

Dorsal plate 100-130 \times 92-115 μm ; ventral plate 128-150 \times 78-119 μm ; toes 20-40 μm .

Distribution: U.S.A., in soft acid waters with Sphagnum. Single record from Qld

Literature: Koste 1978; Shiel & Koste 1979.

Lecane clara (Bryce)

FIG. 8:5

Cathypna clara Bryce, 1982, p.271, text fig.

Lecane clara Harring 1913, p.60.

Diagnosis: Very flexible membranous lorica; anterior margins not coincident; dorsal lightly convex, ventral concave; no spines at external angles; no markings on dorsal plate; toes long,

Fig. 9. 1, *Lecane curvicornis* (Murray): (a) dorsal; (b) ventral. 2, *L. doryssa* Harring: (a) dorsal; (b) ventral. 3, *L. elsa* Hauer: (a) dorsal; (b) ventral. 4, *L. flexilis* (Goësse): (a) dorsal; (b) ventral. 5, *L. formosa* Harring & Myers: (a) dorsal; (b) ventral. 6, *L. glypta* Harring & Myers: (a) dorsal; (b) ventral. Fig. 9: 1-4-6, after Harring & Myers (1926); 2, after Haller (1938); 3, after Hauer (1931). Scale lines 50 μm .

robust, $\frac{1}{2}$ total length, terminating in bristle-like spicule.

Total length 170-200 μm ; dorsal plate 72-83 \times 40-62 μm ; ventral plate 75-90 \times 40-55 μm ; toes 25-40 μm .

Distribution: N. America in *Sphagnum*. Single unconfirmed record from Vic.

Literature: Berzins 1982.

Lecane crepida Herring

FIG. 8:6

Lecane crepida Herring, 1914, p.533, Pl. 22, Figs 4-7.

Diagnosis: Head aperture dorsal margin slightly convex, ventral slightly concave; two short stout incurved cusps at external angles; dorsal plate smaller than ventral, strongly convex; three pairs of divergent wavy ridges on dorsal anterior surface; ventral plate with interrupted longitudinal pleats; no lateral sulci; toes $>\frac{1}{4}$ total length; claw long, slender.

Dorsal plate 75 \times 45 μm ; ventral plate 100 \times 68 μm ; toes 40 μm ; claws 9-10 μm .

Distribution: Often numerous in tropical and subtropical shallow waters. Single record; L. Mulwala, Vic. 24.2°C, pH 7.7, DO 8.6 mg l⁻¹, 60 $\mu\text{s cm}^{-1}$, 22 NTU.

Literature: Koste 1978.

Lecane curvicornis (Murray)

FIG. 9:1

Cathypna curvicornis Murray, 1913a, p. 346, Fig. 14:22.
Lecane curvicornis Herring 1914, p.535, Fig. 17:3.

Diagnosis: Head aperture margins coincident, both with broad V-shaped sinuses; two large cusps at external angles; ventral plate much wider than dorsal, with transverse fold; posterior segment rounded; toes $\frac{1}{3}$ total length.

Dorsal plate 110-120 \times 95-112 μm ; ventral plate 130-145 \times 105-116 μm ; toe 48-79 μm ; claw 8-13 μm .

Distribution: Abundant in tropical and subtropical shallow waters. Rare: Finnis R. and Magela Creek, N.T., Coongie Lakes, S.Aust. and southwest W.A. 24.5-29.8°C, pH 5.2-6.3, DO 3.0-6.1 mg l⁻¹, 28-59 JS cm⁻¹, alk. 1.9 mg l⁻¹.

Literature: Koste 1978; Berzins 1982; Koste & Shiel 1983.

Lecane doryssa Herring

FIG. 9:2

Lecane doryssa Herring, 1914, p. 542, Pl. 21, Figs 4-6.

Diagnosis: Head aperture margins not coincident; dorsal slightly convex, ventral almost straight; no cusps at external angles; dorsal plate faceted, ventral plate with complex pattern (Fig. 8:2b)

posterior segment projects well beyond dorsal plate; $>\frac{1}{2}$ second foot segment projects beyond lorica margin; toes long, slender, reducing to needle-like pseudoclaw at approx. $\frac{1}{2}$ their length.

Dorsal plate 58 \times 60 μm , ventral plate 58 \times 58 μm ; head aperture width 52 μm ; toes 30-32 μm ; pseudoclaw 13 μm .

Distribution: Central Europe, Central America, Amazonia, Asia, Indonesia, in periphyton. Rare: Magela Creek, N.T. and acid waters of western Tasmania. 12.0-29.9°C, pH 3.1-6.3, DO 5.5-5.8 mg l⁻¹, 26-81 $\mu\text{s cm}^{-1}$.

Literature: Koste 1978, 1981; Koste et al. (1988).

Lecane elsa Hauer

FIG. 9:3

Lecane elsa Hauer, 1931, p. 8, Fig. 2.

Diagnosis: Head aperture margins not coincident; dorsal convex, ventral biconvex (with median notch); occasionally tiny spines at frontal angles; dorsal plate smooth, smaller than ventral plate; ventral plate with distinct transverse fold; posterior plate with tongue-like elongation over foot segments; lateral sulci deep; toes slender, $<\frac{1}{2}$ body length, tapering to distinct claw.

Dorsal plate 122-140 \times 102-113 μm ; ventral plate 133-160 \times 106-128 μm ; toes 60-66 μm ; claws 9-10 μm .

Distribution: Rare in littoral of large water bodies, but abundant in floodplain waters and inundation zones of central Europe, Amazonia. Rare: N.T., W.A., Vic. 20.0-31.1°C, pH 5.4-7.2, DO 6.7-9.1 mg l⁻¹, 25 $\mu\text{s cm}^{-1}$, Alk. 2.3 mg l⁻¹.

Literature: Koste 1978, 1981; Koste et al. 1983.

Lecane flexilis (Gosse)

FIG. 9:4

Distyfa flexilis Gosse in Hudson & Gosse, 1886, p. 77, Fig. 24:7.

Lecane flexilis Herring 1913, p.61.

Diagnosis: Head aperture margins coincident, convex, with two short cusps at external angles; dorsal plate faceted, rounded posteriorly; ventral plate narrower than dorsal, less distinctly ornamented; lateral sulci indistinct; toes long, slender, $\frac{1}{4}$ body length, tapering distally to small, acute recurved claw with small dorsal basal spicule.

Dorsal plate 72-76 \times 63-66 μm ; ventral plate 66-90 \times 50-60 μm ; toes 22-50 μm ; claws 3-5 μm .

Distribution: Cosmopolitan, eurytherm, regarded by Koste (1978) as a possible alkalophile, N.T., Tas., Vic., common, abundant in humic acid waters in Tasmania. 8.2-29.0°C, pH 3.1-8.4, DO 6.1-10.7 mg l⁻¹, 9.780 $\mu\text{s cm}^{-1}$, 17.4 NTU.

Literature: Koste 1978, 1981; Koste et al. 1988.

Lecane formosa Herring & Myers

FIG. 9:5

Lecane formosa Herring & Myers, 1926, p. 360,
Figs 29:1, 2.

Diagnosis: Head aperture margins straight, coincident; no corner spines; dorsal plate smooth, narrower than ventral plate at anterior margin; ventral plate with single transverse fold, two longitudinal lines; posterior segment broadly rounded, projects beyond dorsal plate; toes $\frac{1}{3}$ total length, straight, slightly tapered; claw long, acute, slender.

Total length 110 μm ; dorsal plate 74 \times 68 μm ; ventral plate 80 \times 68 μm ; toes 25 μm ; claws 7 μm .

Distribution: U.S.A. Single unverified record from

Hunter R., N.S.W.

Literature: Literature: Berzins 1982.

Lecane glypta Herring & Myers

FIG. 9:6

Lecane glypta Herring & Myers, 1926, p. 360,
Figs 26:1, 2.

Diagnosis: Head aperture dorsal margin convex, ventral slightly concave, with two small spines at frontal corners; dorsal and ventral surfaces intricately patterned; lateral sulci indistinct; toes $\frac{1}{4}$ total length, slender, parallel-sided; claws small, acute.

Dorsal plate 75-80 \times 50 μm ; ventral plate 80-86 \times 42-46 μm ; toes 22-27 μm ; claws 5 μm .

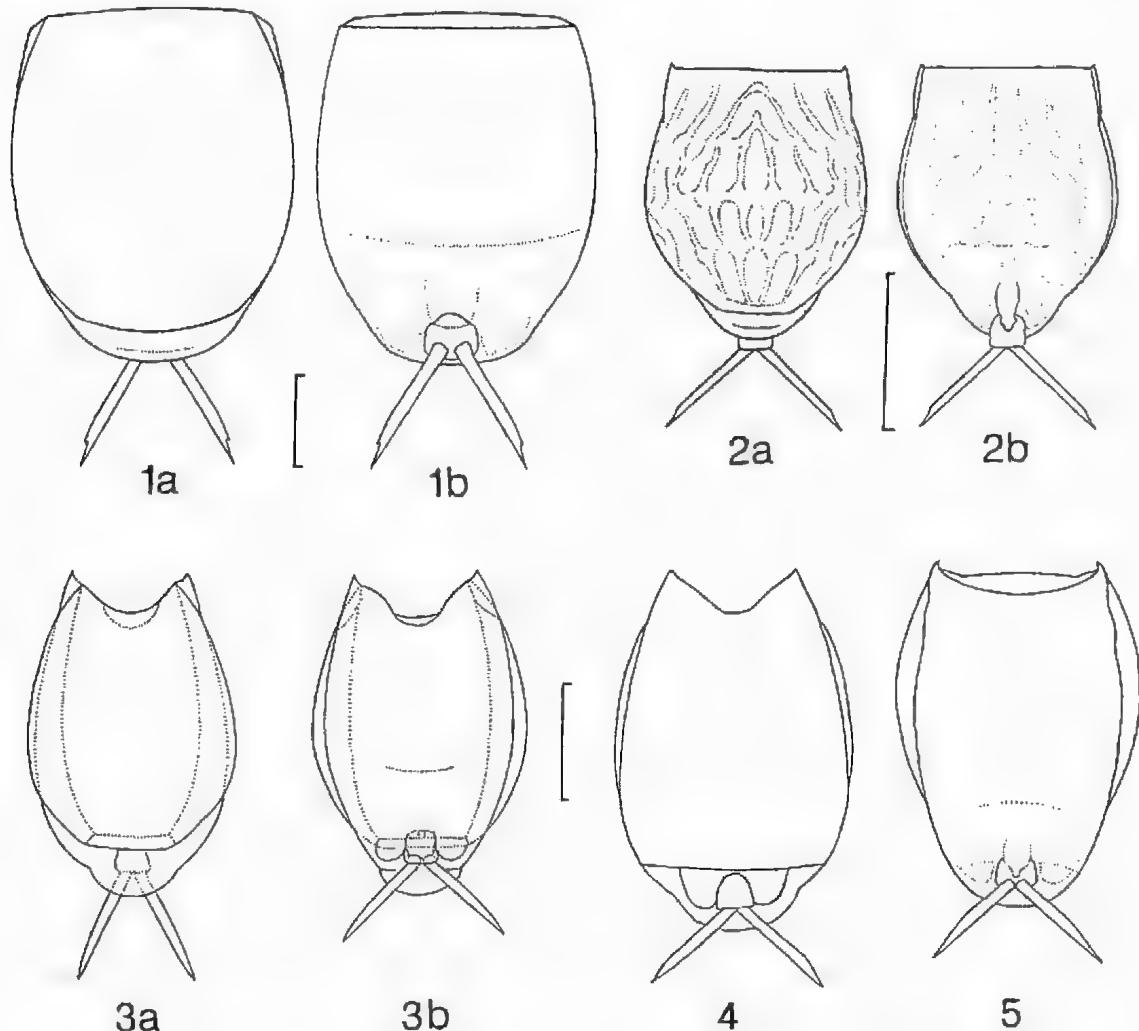
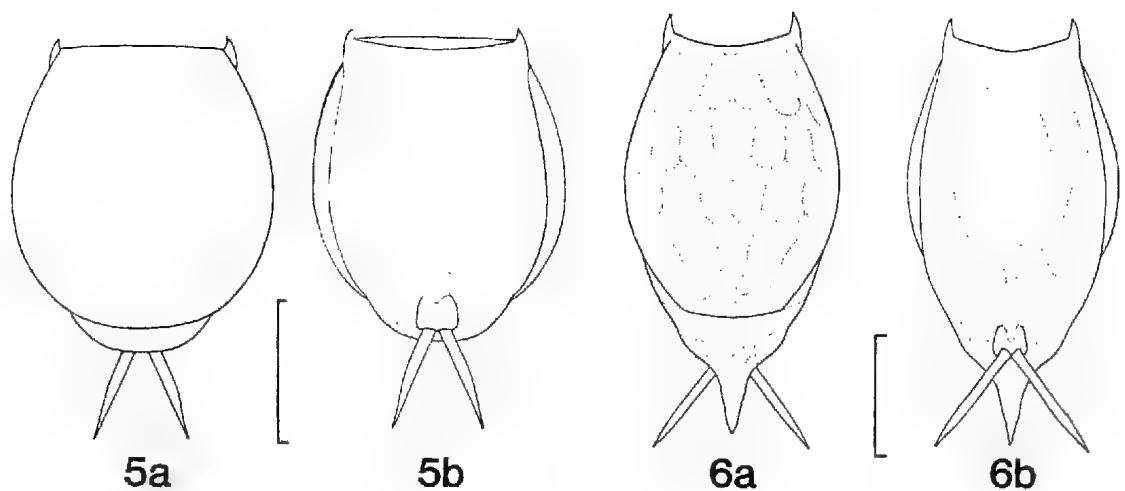
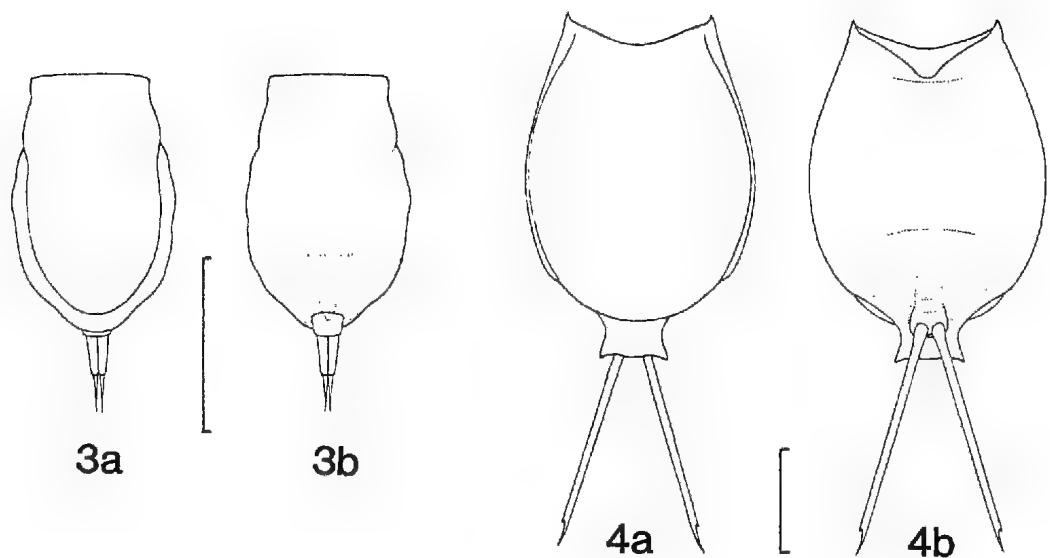
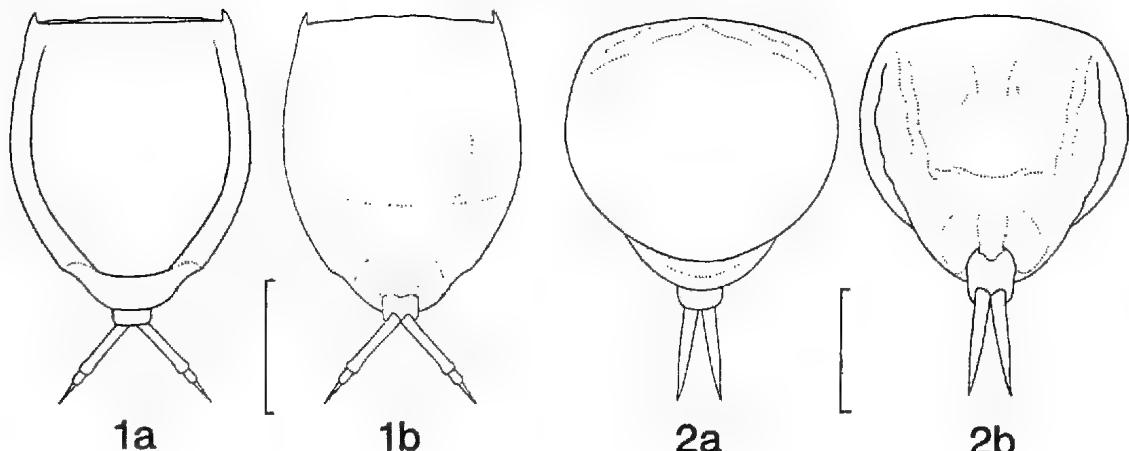


Fig. 10. 1, *Lecane grandis* (Murray); (a) dorsal; (b) ventral. 2, *L. halicylsta* Herring & Myers; (a) dorsal; (b) ventral. 3, *L. herzigi* Koste et al.; (a) dorsal; (b) ventral. 4, *L. mitis* Herring & Myers; ventral. 5, *L. ordwayi* Bienert; ventral. Fig. 10; 1, 2, 4, after Herring & Myers (1926); 3, after Koste et al. (1988); 5 after Bienert (1986). Scale lines 50 μm .



Distribution: N. America, Europe, Middle-East, Asia. Single record, Bicheno-Freyne area, eastern Tasmania, 14°C.

Literature: Koste 1978; Koste & Shiel 1985, 1987a.

Lecane grandis (Murray)

FIG. 10:1

Cathypna grandis Murray, 1913a, p. 344, Fig. 13:20.
Lecane grandis Fadeev 1925, p. 20, Fig. 1:6.

Diagnosis: Head aperture margins straight; smooth dorsal plate projects slightly ahead of ventral plate; both plates of similar shape; single transverse fold of ventral plate; posterior segment broad, truncate; toes long, blade-shaped; conical claw with basal spicule.

Dorsal plate 165–180×118–140 µm; ventral plate 175–200×118–140 µm; toes 72–80 µm; claws 10–12 µm.

Distribution: Possibly cosmopolitan in brackish/athalassic saline waters. Euryhaline. Single record, Billabong, Jabiluka, N.T. 25.0°C, pH 6.2, DO 3.0 mg l⁻¹, 48 µS cm⁻¹.

Literature: Koste 1978.

Lecane halicylsta Harring & Myers

FIG. 10:2

Lecane halicylsta Harring & Myers, 1926, p. 348, Figs 21:3, 4.

Diagnosis: Head aperture margins coincident, straight, with two small spines at frontal corners; dorsal plate faceted, each facet with double margins; ventral plate also patterned, less regularly than dorsal; caudal plate rounded, projects slightly beyond dorsal plate; toes > 1/4 body length, straight, ending in indistinct acute claw.

Dorsal plate 71–90×58–78 µm; ventral plate 82–105×56–74 µm; anterior margin 55–60 µm; toes 31–42 µm; claws 8 µm.

Distribution: Europe, Asia, North and South America, rare in soft vegetated waters. Single record: South Esk R., Perth, Tas. 12.7°C, pH 6.0.

Literature: Koste & Shiel 1987a.

Lecane hastata (Murray)

FIG. 11:1

Cathypna hastata Murray, 1913a, p. 348, Fig. 14:25.
Lecane hastata Harring & Myers 1926, p. 363, Figs 28:5, 6.

Diagnosis: Head aperture margins not coincident; dorsal slightly convex, ventral straight; two small spines at external angles; dorsal plate smaller than ventral, truncate posteriorly; both surfaces finely

stippled; ventral plate also with transverse fold and two longitudinal lines; no lateral sulci; toes long, > 1/4 total length, with distal dilation, terminating in long acute claw.

Dorsal plate 74–97×50–79 µm; ventral plate 96–115×74–90 µm; toes 37–41 µm; claws 14–18 µm.

Distribution: Possibly cosmopolitan in periphyton, fresh and slightly saline waters. Recorded in L. Grace, southwest W.A., with a possible record from Cairns, nth Qld (C. H. Fernando pers. comm.).
Literature: Koste et al. 1983.

Lecane herzigi Koste, Shiel & Tan

FIG. 10:3

Lecane herzigi Koste, Shiel & Tan, 1988, p. 125, Fig. 12:14.

Diagnosis: Lorica widest medially, ovate; anterior margins with deep rounded sinuses, ventral deeper; short, incurving pointed cusps at external angles; dorsal plate ovate, truncate posteriorly, slightly wider than ventral plate; ventral plate with clearly demarcated posterior lobe commencing at second foot segment; deep lateral sulci; coxal plates small; toes straight to acute point, no claws.

Dorsal plate 96×74 µm, ventral plate 177×70 µm, width anterior margin 41 µm, toes 38–39 µm.

Distribution: Endemic, dune pools, western Tasmania, 17.0°C, pH 3.1–4.3; 80.6–98.3 IS cm⁻¹, 0.5 NTU.

Comment: Although we noted the broad similarity of *L. herzigi* to *L. mijit* Harring & Myers (Fig. 10:4) (Koste et al. 1988) we missed the strikingly similar *L. ordwayi* Bienert, 1986 (Fig. 10:5), described from Florida. Comparative measurements are:

Dorsal plate 113–121×88–99 µm, ventral plate 125–142×82–92 µm, width anterior margin 40–52 µm, toes 40–44 µm.

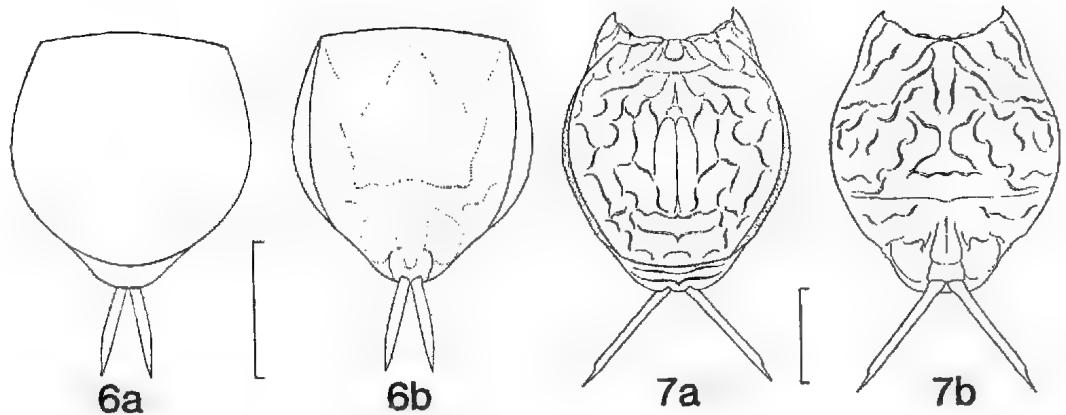
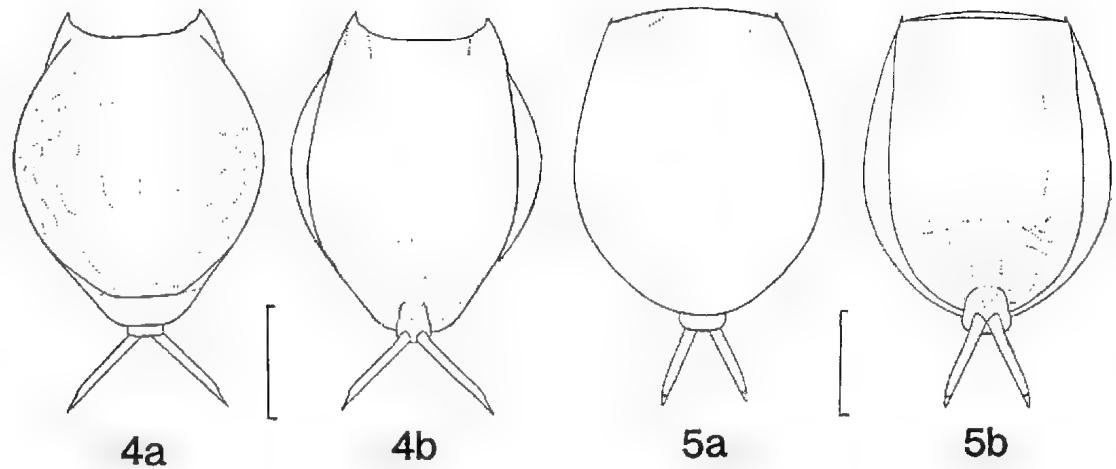
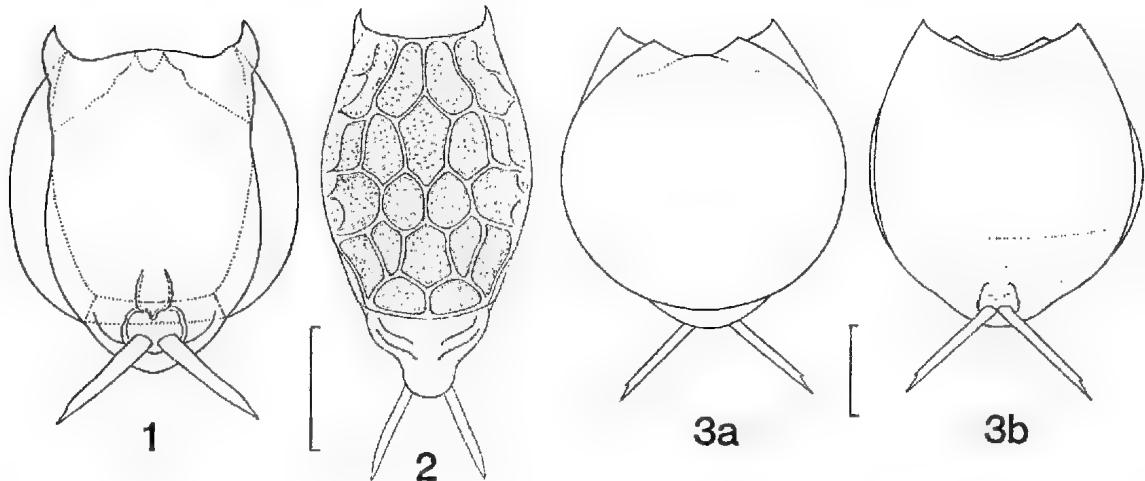
Both *L. herzigi* and *L. ordwayi* were recorded from highly coloured, low pH waters. The affinity of the two taxa may be defined by comparative SEM trophi analysis, however at this time, in view of the morphological differences, we are satisfied that they are not conspecific. *L. herzigi* differs significantly in body proportions, it has a proportionately smaller dorsal plate, with a more elongate, narrower ventral plate, the head aperture margins are more rounded, it lacks a transverse fold above the second foot joint, the lobate posterior segment is distinctive, and there are obvious differences in the coxal region.

Lecane hornemannii (Ehrenberg)

FIG. 11:2

Euchlanis hornemannii Ehrenberg, 1834, pp. 206, 220.
Lecane hornemannii Harring 1914, p. 543.

Fig. 11: 1, *Lecane hastata* (Murray); (a) dorsal; (b) ventral. 2, *L. hornemannii* (Ehrenberg); (a) dorsal; (b) ventral. 3, *L. inermis* (Bryce); (a) dorsal; (b) ventral. 4, *L. leontina* (Burner); (a) dorsal; (b) ventral. 5, *L. levistyla* (Olofsson); (a) dorsal; (b) ventral. 6, *L. ludwigii* (Eckstein); (a) dorsal; (b) ventral. Fig. 11: 1–6, after Harring and Myers (1926). Scale lines 50 µm.



Diagnosis: Lorica broader than long with very deep cross-section; head aperture margins coincident, convex; no frontal cusps; dorsal lorica ornamented with embossed hemispheres corresponding to usual facets (only anterior rows shown on Fig. 11:2a) without distinct demarcations between; ventral plate pyriform with transverse and longitudinal folds; posterior segment projects beyond dorsal plate; second foot segment projects beyond posterior segment; toes $\frac{1}{4}$ total length, tapering to long, conical outcurving points without claws.

Total length 100-140 μm ; dorsal plate 72-110 \times 82-100 μm ; ventral plate 84-115 \times 72-110 μm ; toes 30-35 μm .

Distribution: Widespread in fresh water, particularly tropics and subtropics. Occasionally in slightly saline waters. All states except S.Aust., rare: 19.9-24.5°C, pH 6.0-7.2, DO 5.1-5.8 mg l⁻¹, 59.85 $\mu\text{s cm}^{-1}$.

Literature: Koste 1978, 1981; Green 1981; Berzins 1982; Koste et al. 1983; Shiel & Koste 1985.

Lecane inermis (Bryce)

FIG. 11:3

Distyla inermis Bryce, 1892, p. 274, text fig.

Lecane inermis: Harring 1913, p. 61.

Diagnosis: Membranous, very flexible lorica; anterior margins coincident, (usually) straight; ventral plate wider than dorsal, both without ornamentation; foot segment rounded, projects beyond dorsal plate; second foot segment projects beyond lorica; toes short, straight, terminate in acute recurved claw almost as long as toe.

Total length 92-154 μm ; dorsal plate 52-80 \times 36-48 μm ; ventral plate to 96 \times to 48 μm ; toes 14-16 μm ; claws 10-12 μm .

Distribution: In athalassic saline waters, in thermal springs and warm waters, eurytopic (pH 4.8-10.0, 5.9-43.0°C) (Koste 1978). Kutikova (1970) recorded *L. inermis* from a geyser at 62.5°C. Rare; not recorded in this study, but noted by Berzins (1982) from several localities in Victoria (presumably cooler waters: April, July).

Lecane leontina (Turner)

FIG. 11:4

Cathypna leontina Turner, 1892, p. 61, Fig. 1.12.

Lecane leontina: Harring 1913, p. 61.

Diagnosis: Head aperture margins not coincident; dorsal concave, ventral with broad V-shaped sinus, rounded at apex; two small cusps at external angles; dorsal plate unornamented, ventral with indistinct

transverse fold; posterior segment protrudes over foot as a quadrangular plate with undulate posterior margin or two divergent lateral spines; toes extremely long, almost body length, terminating in long claw with basal spine.

Dorsal plate 138-170 \times 115-147 μm ; ventral plate 168-249 \times 118-152 μm ; toes 92-154 μm , claws 11-15 μm .

Distribution: In vegetated shallow waters, tropical and subtropical lake littorals. Rare, possibly widespread in northern Australia, although records are few: N.T., Qld, S.Aust. (Coongie Lakes), W.A. (Kimberley) (last two records: Shiel unpubl.), 24.0-25.0°C, pH 6.0-6.3, DO 5.1-5.8 mg l⁻¹, 42-59 $\mu\text{s cm}^{-1}$.

Literature: Shiel & Koste 1979; Koste 1981.

Lecane levistyla (Olofsson)

FIG. 11:5

Cathypna levistyla Olofsson, 1917, p. 280, Fig. 10.

Lecane scobis Harring & Myers, 1926.

Diagnosis: Head aperture margins not coincident; dorsal straight, ventral concave; incurved small cusps at external angles; ventral plate narrower than dorsal, both unornamented; second foot segment projects slightly beyond dorsal margin; toes $>\frac{1}{4}$ total length, tapering from $\frac{1}{2}$ their length to acute points (no claw).

Dorsal plate 95-115 \times 93-113 μm ; ventral plate 110-140 \times 61-100 μm ; toes 35-45 μm , claws 15-18 μm .

Distribution: Cosmopolitan in inundation areas. Rare: single record from Magela Creek, N.T. 28.5°C, pH 5.4, DO 6.2 mg l⁻¹, 23 $\mu\text{s cm}^{-1}$.

Literature: Koste 1978, 1981.

Lecane ludwigi (Eckstein)

FIG. 11:6

Distyla ludwigi Eckstein, 1883, p. 383, Fig. 26:37.

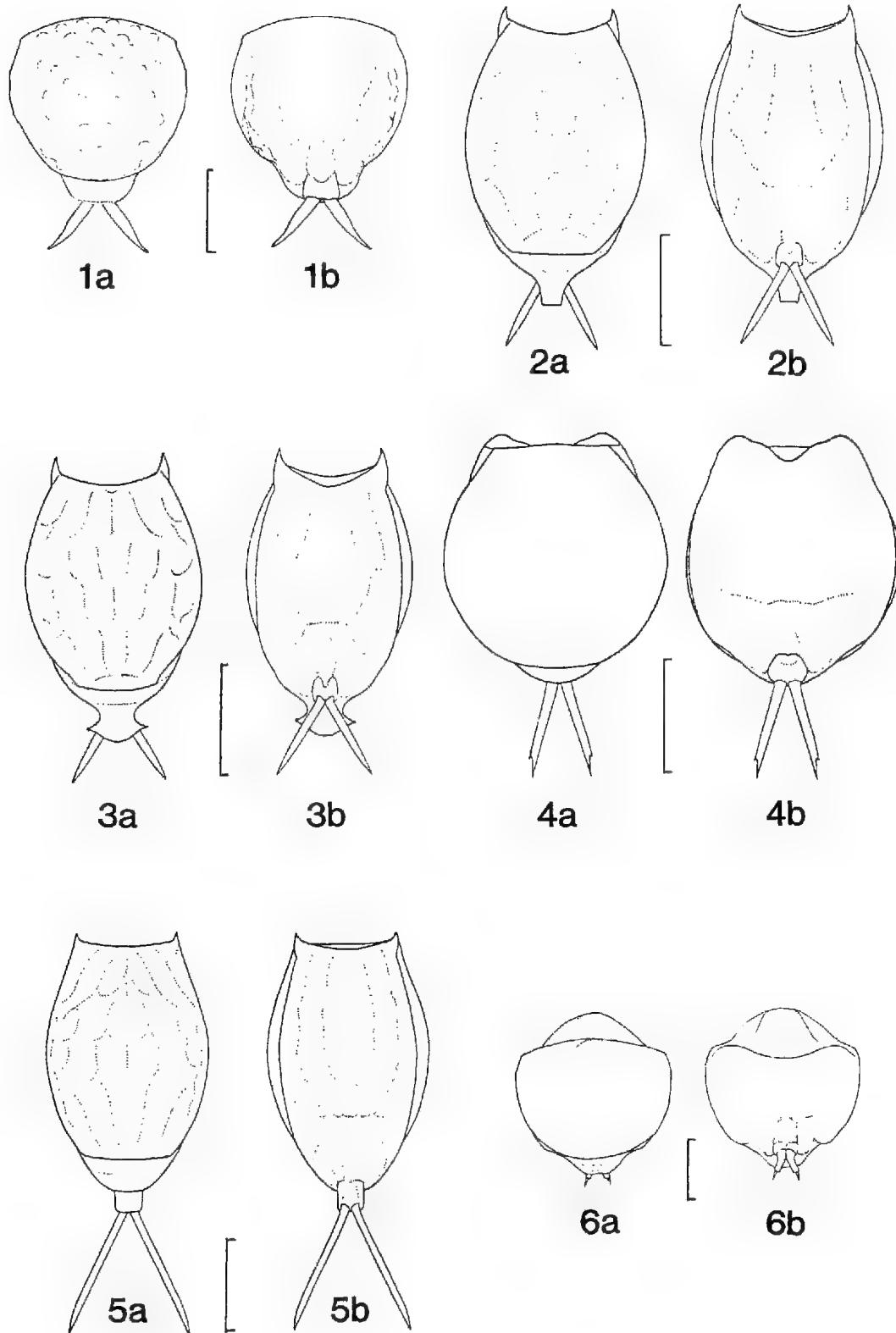
Lecane ludwigi: Harring 1913, p. 61.

Diagnosis: Head aperture margins coincident, concave; two stout cusps at external angles; dorsal plate truncate posteriorly, ornamented with four rows of tessellations to give shingled appearance (Fig. 11:6a); ventral plate with transverse fold and several longitudinal ridges; lateral sulci very deep; posterior segment produced to long, triangular pointed spine; toes long, slender, $\frac{1}{2}$ total length, tapering to acute conical points (no claw).

Dorsal plate 104-121 \times 77-84 μm ; ventral plate to 162 \times 10-80 μm ; toes 40-44 μm , subitaneous egg 102 \times 45 μm .

Distribution: Cosmopolitan warm stenotherm.

Fig. 12. 1, *Lecane* sp.; ventral. 2, *L. ludwigi* ererves (Harring); dorsal. 3, *L. lunu* (Müller); (a) dorsal; (b) ventral. 4, *L. mira* (Murray); (a) dorsal; (b) ventral. 5, *L. mylaris* Harring & Myers; (a) dorsal; (b) ventral. 6, *L. nona* (Murray); (a) dorsal; (b) ventral. 7, *L. nuda* (Murray); (a) dorsal; (b) ventral. Fig. 12: 3-6, after Harring & Myers (1926); 7, after Hauer (1938). Scale lines 50 μm .



Rare; the typical form is known from N.T., Qld., southwest W.A. 12.0-17.0°C; pH 4.3-4.8, 26-98 $\mu\text{S cm}^{-1}$. *L. ludwigi laticaudata* Hauer (1938) occurs in Coongie Lakes, S.Aust. (Shiel unpubl.).

Lecane luna (Müller)
FIG. 12:3

Cercaria luna Müller, 1776, p. 280.
Lecane luna: Nitzsch 1827, p. 68.

Diagnosis: Head aperture margins not coincident; both with deep lunate sinuses, dorsal anteriorly $\frac{2}{3}$ width of ventral; external angles of ventral sinus cusp-like, dorsal sinus angles more blunt; smooth dorsal plate almost circular with broad median anterior hump (Fig. 12:3a), ventral plate slightly narrower with single transverse fold; posterior segment small, rounded, projects slightly beyond dorsal plate; toes $\frac{1}{3}$ total length, terminate in claw with basal spicule.

Dorsal plate 122-163 \times 102-150 μm ; ventral plate 132-177 \times 104-80 μm ; toes 44-64 μm ; claws 8-10 μm .
Distribution: Cosmopolitan in littoral of fresh-, eutrophic saline and estuarine waters. Pancontinental, common. 10.0-27.0°C, pH 4.6-8.4, DO 5.8-10.0 mg l⁻¹, 37-330 $\mu\text{S cm}^{-1}$, <1-160 NTU.
Literature: Evans 1951; Koste 1978, 1981; Koste & Shiel 1979; Berzins 1982.

Lecane mira (Murray)
FIG. 12:4

Cathypna mira Murray, 1913c, p. 553, Fig. 22:3
Lecane mira: Hanning & Myers 1926, p. 342, Figs 17:5, 6.

Diagnosis: Head aperture margins not coincident; dorsal almost straight, ventral slightly concave; two stout triangular cusps at external angles; dorsal plate indistinctly faceted, with anterior row incomplete; ventral plate with light transverse fold only; lateral sulci deep; posterior segment truncate, projects beyond dorsal plate; second foot segment visible beyond posterior segment; toes $\frac{1}{4}$ total length, terminate in stout claw with basal spicule.

Dorsal plate 108-132 \times 97-130 μm ; ventral plate to 145 \times 100 μm ; toes 50-56 μm ; claws 9-12 μm .

Distribution: Widely distributed in acid (*Sphagnum*) waters. There is an unverified record of *L. mira* from Qld (Berzins 1982). A single individual from L. Mulwala, Vic. has some features of *L. mira*, however as shown by the ventral view (Fig. 12:1), there are several morphological differences, particularly in the posterior plate, foot and toes, which suggest that specific status may be warranted. Further material is necessary for adequate description.

Literature: Koste 1978

Lecane mylacriscis Hanning & Myers
FIG. 12:5

Lecane mylacriscis Hanning & Myers, 1926, p. 359, Figs 25:5, 6.

Diagnosis: Head aperture margins almost coincident; ventral straight, dorsal slightly convex; two minute spines at external angles; dorsal plate smooth, larger than ventral plate; ventral plate with distinct folds (Fig. 12:5b); > $\frac{1}{4}$ second foot segment projects beyond posterior margin; toes inserted ventrally part way along segment rather than at usual distal end; external margins of toes curve in distally to small pointed claws.

Dorsal plate 145 \times 108 μm ; ventral plate 130 \times 82 μm ; anterior margin width 72 μm ; toes 32 μm ; claws 7 μm .

Distribution: North America. Not recorded in our collections. Unconfirmed record from central Vic.

Literature: Koste 1978; Berzins 1982.

Lecane nana (Murray)
FIG. 12:6

Cathypna nana Murray, 1913a, p. 53, Fig. 14:29a-c.
Lecane nana: Hanning 1914, p. 536.

Diagnosis: Anterior margins coincident and convex, without corner spines; dorsal plate smooth, wider than ventral plate, which has several disconnected lines (Fig. 12:6b); posterior segment small, truncate, projects beyond dorsal margin, covers second foot segment; toes straight on inner edges, outer margins taper to point, no claw.

Total length 85-90 μm ; dorsal plate 45-64 \times 44-62 μm ; ventral plate 52-68 \times 52-60 μm ; frontal width 36 μm ; toes 20-30 μm .

Distribution: Cosmopolitan in fresh and brackish water. Rare; Qld, Tas., Vic. 15.5-18.5°C, pH 6.8-7.4, DO to 11.0 mg l⁻¹, 70-565 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Shiel & Koste 1979; Green 1981; Berzins 1982.

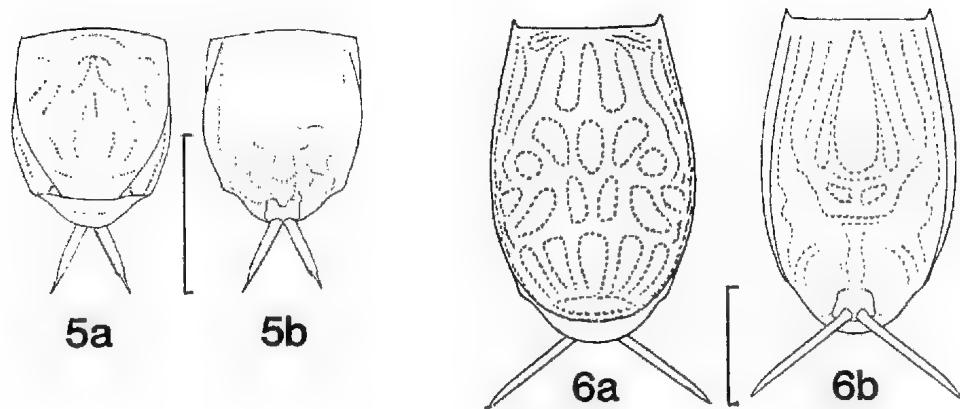
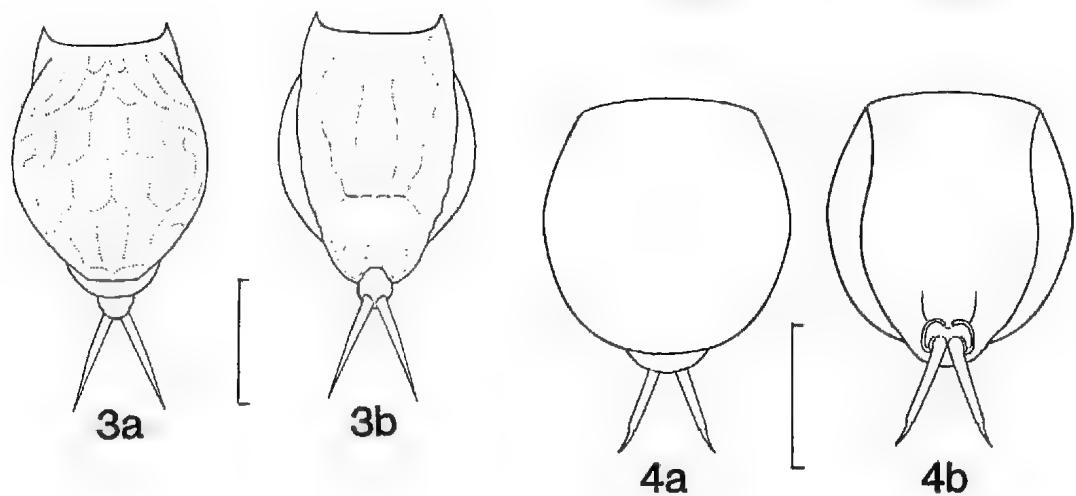
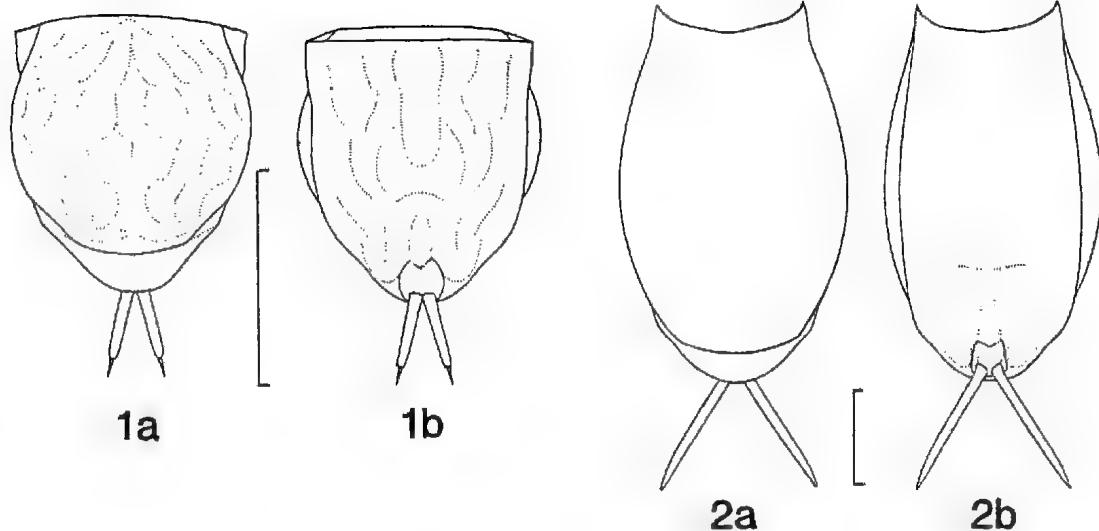
Lecane nitida (Murray)
FIG. 12:7

Cathypna nitida Murray, 1913a, p. 347, Fig. 14:24a, b.
Lecane curvicornis Hanning & Myers, 1926, p. 321, Fig. 7:1, 2.

L. curvicornis nitida: Hauer 1938, p. 513, Fig. 37a, b.

Diagnosis: Lorica broadly resembles *L. curvicornis*, however, unlike that species both dorsal and ventral plates are distinctively ornamented; posterior plate also with distinct lines and more rectangular than that of *L. curvicornis*; head aperture margins show

Fig. 13. 1, *Lecane nodosa* Hauer; (a) dorsal; (b) ventral. 2, *L. ohtensis* (Herrick); (a) dorsal; (b) ventral. 3, *L. phioensis* Ichthyoma (Anderson & Shepherd); (a) dorsal; (b) ventral. 4, *L. papuana* (Murray); (a) dorsal; (b) ventral. 5, *L. pertica* Hanning & Myers; (a) dorsal; (b) ventral. 6, *L. pumila* (Rousselet). (a) dorsal; (b) ventral. Fig. 13: 1, 6, after Hauer (1938), 2-5, after Hanning & Myers (1926); 5, after Hauer (1938). Scale lines 50 μm



some irregularity of broad V-shape; dorsal plate relatively broader; toes impinge on distal end of second foot segment rather than on ventral surface as in *L. curvicornis*. No measurements are given for *L. nilda* by Herring & Myers (1926) or Koste (1978), however those by Hauer (1938) indicate a larger animal than *L. curvicornis*.

Dorsal plate 127×117 µm; ventral plate 124 µm wide; head aperture 62 µm; toes 78 µm; claw 12 µm.

Distribution: South America. Single record from Magela Ck, N.T.

Literature: Koste 1981.

Lecane nodosa Hauer

FIG. 13:1

Lecane nodosa Hauer, 1938, p. 520, Fig. 421, h

Diagnosis: Head aperture margins coincident, convex; no corner spines; dorsal plate wider than long, rounded posteriorly, covered with regular knobby hemispheres (cf. *L. hornemannii*); ventral plate narrower than dorsal, with indistinct lateral margins; no lateral sulci; broad posterior plate covers foot segments; toe stout, broad, parallel-sided for 1/3 its length, tapering to outward-curved point; no claw.

Total length 87-120 µm; dorsal plate 60-81×67-82 µm; ventral plate 70-90×67-77 µm; frontal width 58 µm; toes 23-30 µm.

Distribution: In periphyton, Java, India. Rare: Jabiluka, N.T. and L. Catani, Vic. 24.5°C, pH 6.3, DO 5.8 mg l⁻¹, 59 µS cm⁻¹.

Comment: The possible synonymy of *L. nodosa* with *L. hornemannii* and *L. nana* was noted by Koste (1978). Protrusion of the second foot segment beyond the lorica margin, non-curving toes and larger overall dimensions in *L. hornemannii* readily separate this taxon. *L. nana* is similar in size and outline differing apparently only in toe morphology and dorsal lorica ornamentation, which may represent ecotypic variation of a single species.

Literature: Koste 1981; Berzins 1982.

Lecane ohioensis Herrick)

FIG. 13:2

Distyla ohioensis Herrick, 1885, p. 54, Fig. 1
Lecane ohioensis Hauer, 1913, p. 62.

Diagnosis: Head aperture margins concave, almost coincident (ventral slightly shorter), two stout cusps at external angles; dorsal plate ornamented with four prominent rows of tessellations; ventral plate with a few folds and ridges; posterior segment tapers to median, truncate projection extending 1/3

length of toes; toes parallel-sided, terminate in conical points; no claws.

Dorsal plate 97-100×78-93 µm; ventral plate 114-146×70 µm; toes 35-40 µm.

Distribution: Cosmopolitan in littoral of freshwaters. Rare: N.T., Qld., S.Aust., Tas. (in moderately saline stock dams, east coast), Vic. 10.2-29.9°C, pH 5.5-8.1, 44-6600 µS cm⁻¹, alkal. 2.6 mg l⁻¹.

Comment: A variant described from Victoria by Anderson & Shephard (1892), *Distyla lechthysura* (*Lecane ichthyoura*) (Fig. 13:3) was synonymised with *L. ohioensis* by Koste (1978). The only difference between the two is the fishtail form of the caudal process in the former, which is variable. *L. ohioensis ichthyoura* apparently is a cosmopolitan halophile. Rare: S.Aust., Vic. southwest W.A.

Literature: Koste 1978; Koste & Shiel, 1983.

Lecane papuana (Murray)

FIG. 13:4

Distyla papuana Murray, 1913, p. 551, Fig. 22:2.

Lecane papuana: Harting & Myers 1926, p. 336, Figs 14:3, 4.

Diagnosis: Head aperture margins not coincident; dorsal almost straight, ventral with broad shallow V-shaped sinus with undulate sides, rounded posteriorly; no cusps at external angles, but distinctive rounded lobes of ventral lorica project well beyond dorsal margin; lateral sulci moderately deep; ventral plate slightly narrower than dorsal, with same circular outline; posterior segment rounded, projects slightly; toes >1/4 total length, slightly dilated distally before stout claw, which has two basal spicules.

Dorsal plate 92-120×82-102 µm; ventral plate 112-115×91-98 µm; toes 34-50 µm; claw 8-12 µm.

Distribution: Between macrophytes in tropical and subtropical shallow waters. Rare: N.T., Qld., S.Aust., Vic. 17.0-29.8°C, pH 5.3-8.2, DO 6.1-9.7 mg l⁻¹, 23-1000 µS cm⁻¹, 40-88 NTU, alkal. 1.9-2.7 mg l⁻¹.

Literature: Koste 1978, 1981.

Lecane pertica Hauer & Myers

FIG. 13:5

Lecane pertica Hauer & Myers, 1926, p. 340, Fig. 12:1, 2.

Diagnosis: Elongate lorica, dorso-ventrally compressed; head aperture margins almost coincident; dorsal straight, ventral slightly concave; two small spines at external angles; dorsal plate truncate posteriorly, indistinctly faceted; ventral

Fig. 14. 1, *Lecane pusilla* Hauer: (a) dorsal; (b) ventral. 2, *L. pyrrhu* Hauer & Myers: (a) dorsal; (b) ventral. 3, *L. rhytiida* Hauer & Myers: (a) dorsal; (b) ventral. 4, *L. rotundata* (Olofsson): (a) dorsal; (b) ventral. 5, *L. ruttemeri* Hauer: (a) dorsal; (b) ventral. 6, *L. signifera signifera* (Jennings): (a) dorsal; (b) ventral. Fig. 14: 1-3, 6 after Hauer & Myers (1926); 5, after Hauer (1938). Scale lines 50 µm.

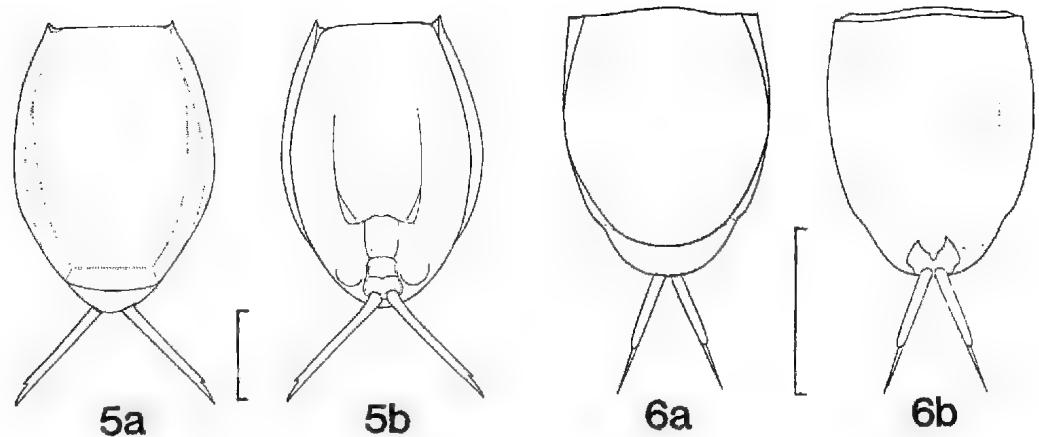
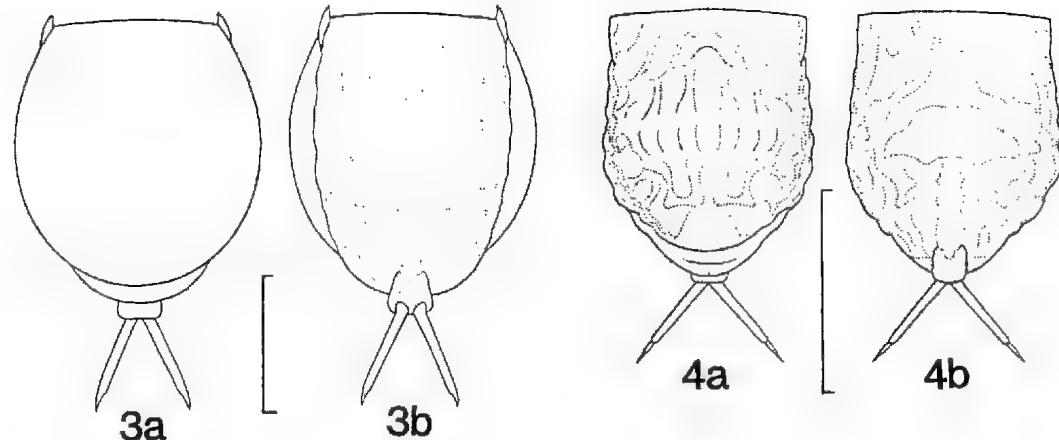
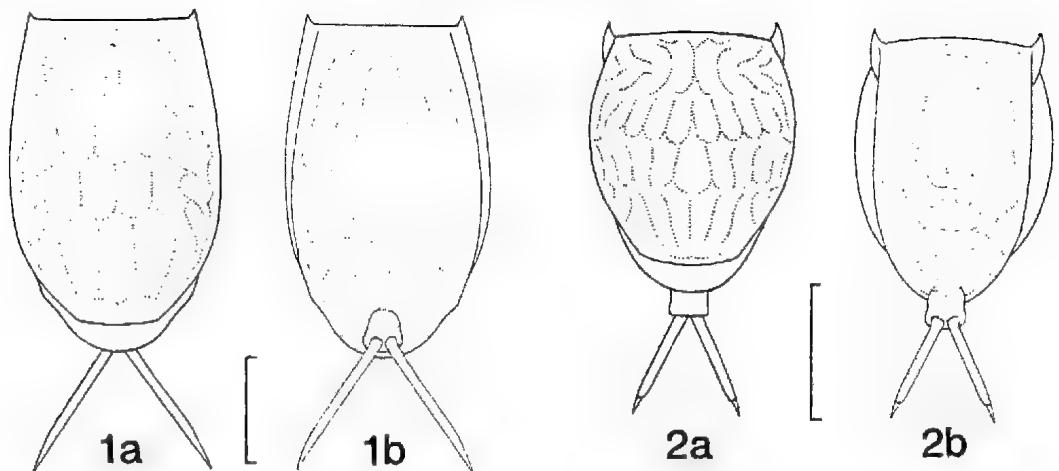


plate clearly marked (Fig. 13:5b); deep lateral sulci; semicircular posterior segment projects well beyond dorsal plate; second foot segment projects almost all its length beyond posterior segment; toes very long, $\frac{1}{2}$ total length, straight, parallel-sided, terminate in acute points; no claws.

Total length to 260 μm ; dorsal plate 97-140 \times 66-100 μm ; ventral plate 115-160 \times 60-88 μm ; anterior margin 46-64 μm ; toes 60-85 μm .

Distribution: North and South America, Indonesia. Acidophil. Rare: billabongs of Magela Creek, N.T. 24.5-29.9°C, pH 5.5-6.3, DO 5.5-5.8 mg l⁻¹, 44.59 $\mu\text{s cm}^{-1}$, alkal. 2.6 mg l⁻¹.

Literature: Koste 1978, 1981.

Lecane pumila (Rousselet)

FIG. 13:6

Notommata pumilla Rousselet, in Murray, 1906, p. 183, Fig. 6:25.

Lecane pumila: Bauer 1936, p. 154, Figs 1-3.

Diagnosis: Lorica flexible, although form constant; lateral sulci absent; toes extremely short; claw points curved backwards.

Total length 75-170 μm ; dorsal plate 60-75 \times 90-140 μm ; ventral plate 80-110 μm ; toes 3-5 μm .

Distribution: Europe, Indonesia, N. America, in moss in standing and flowing water. Single record from L. St Clair, Tasmania, 17.0°C, pH 7.3, 21.1 $\mu\text{s cm}^{-1}$.

Literature: Koste & Shiel 1986a.

Lecane pusilla Harring

FIG. 14:1

Lecane pusilla Harring, 1914, p. 541, Fig. 20:4-6.

Diagnosis: Head aperture margins straight, dorsal projects slightly beyond ventral; no corner spines; dorsal plate distinctly faceted, ventral plate less conspicuously patterned; lateral sulci deep; posterior segment rounded, projecting well beyond dorsal plate margin; toes long, slender, $>\frac{1}{4}$ total length, tapering to long, recurved, acute claw.

Total length to 75 μm ; dorsal plate 54 \times 52 μm ; ventral plate 60 \times 45 μm ; anterior margin 50 μm ; toes 20-26 μm ; claws 5 μm .

Distribution: Central America, E. Europe, Iran. Rare: Bromfield Swamp, Qld, Vic. No ecological information available.

Literature: Koste 1978; Green 1981; Berzins 1982.

Lecane pyrrha Harring & Myers

FIG. 14:2

Lecane pyrrha Harring & Myers, 1926, p. 331, Fig. 12:1-6.

Diagnosis: Head aperture margins coincident, concave; two stout triangular cusps at external angles; no patterning of dorsal or ventral lorica; posterior segment projects slightly beyond dorsal plate; toes long slender, $\frac{1}{4}$ total length, without claws.

Total length to 280 μm ; dorsal plate 193 \times 145 μm ; ventral plate 210 \times 125 μm ; anterior margin 80 μm ; toes 75 μm .

Distribution: North America in soft acid waters. Not recorded in this study. Single report from Victoria by Berzins (1982) needs confirmation.

Lecane rhytida Harring & Myers

FIG. 14:3

Lecane rhytida Harring & Myers, 1926, p. 346, Fig. 20:3, 4.

Diagnosis: Head aperture margins coincident, slightly concave; two stout triangular cusps at external angles; dorsal plate distinctly faceted, ventral with prominent markings (Fig. 14:3b); lateral sulci indistinct; posterior segment small, projects slightly beyond dorsal plate; second foot segment robust, projects $\frac{1}{2}$ its length beyond posterior margin; toes long, slender, $\frac{1}{4}$ total length, tapering to very long acute points.

Total length to 126 μm ; dorsal plate 80 \times 69 μm ; ventral plate 87 \times 65 μm ; anterior margin 42 μm ; toes 39 μm .

Distribution: North America, soft acid water. Not recorded in this study. Single report from Victoria by Berzins (1982) needs confirmation.

Lecane rotundata (Olofsson)

FIG. 14:4

Cathypna rotundata Olofsson, 1918, p. 593, Fig. 53.

Lecane rotundata: Remane 1932, p. 110.

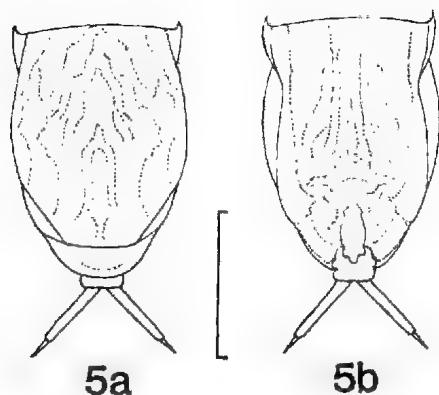
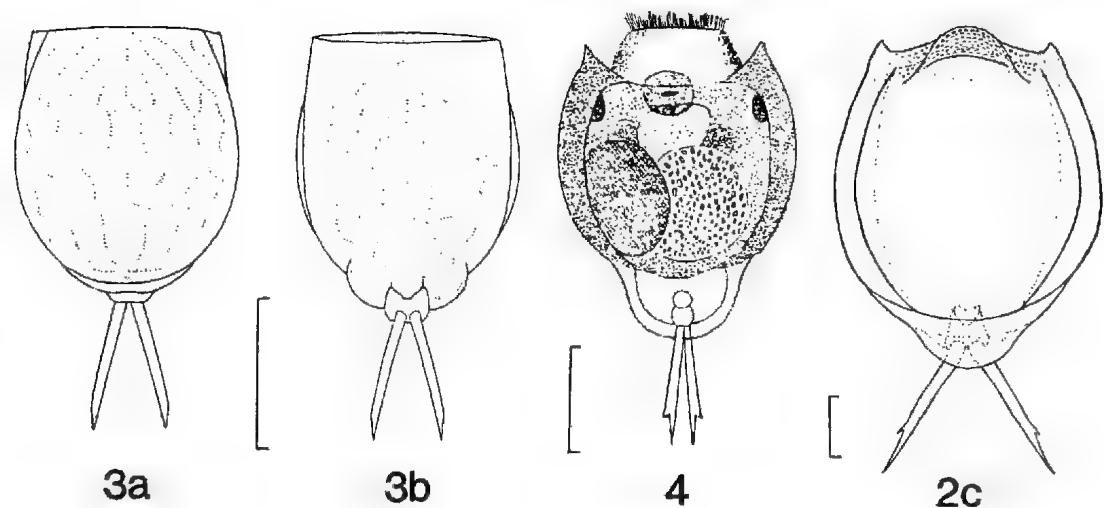
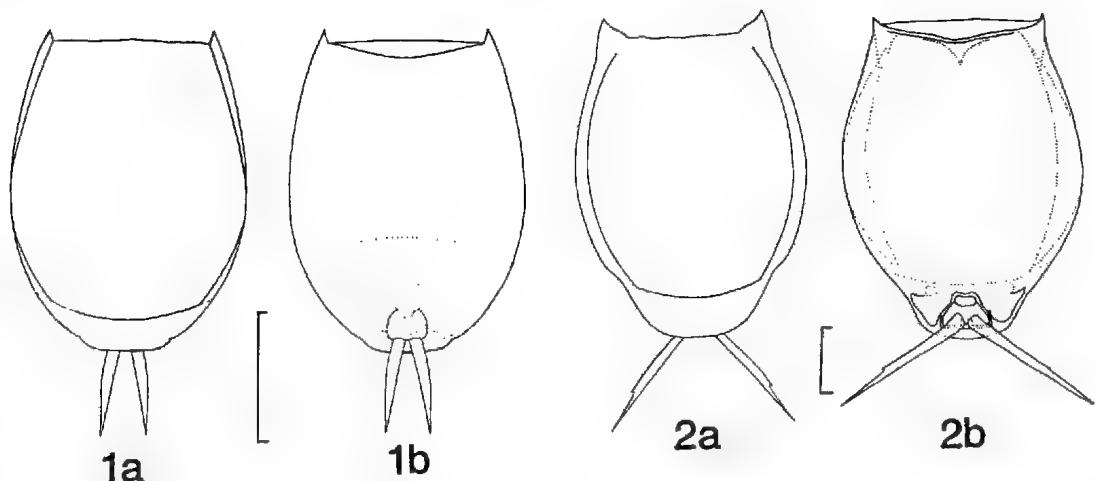
?*Lecane latissima* Yamamoto, 1955, p. 31, Fig. 1a, h.

Diagnosis: Head aperture margins coincident, convex; frontal spines absent; dorsal plate smooth, almost circular, much wider than ventral plate; lateral sulci absent; posterior plate semicircular, projects beyond dorsal margin; toes long; claws short, pointed.

Dorsal plate 90 \times 106-112 μm ; ventral plate 103-113 \times 103 μm ; toes 37-39 μm ; claws 6 μm .

Distribution: Northern Europe, Japan. Only known

Fig. 15. 1, *L. signifera phoenensis* (Voigt): (a) dorsal; (b) ventral. 2, *L. stichaea* Harring: (a) dorsal; (b) ventral. 3, *L. stichaea intrasimulata* (Olofsson): (a) dorsal; (b) ventral. 4, *L. subtilis* Harring & Myers: (a) dorsal; (b) ventral. 5, *L. tasmaniensis* Koste & Shiel: (a) dorsal; (b) ventral. 6, *L. tenuiseta* Harring: (a) dorsal; (b) ventral. Fig. 15: 1-4, 6, after Harring & Myers (1926); 5, after Koste et al. (1983). Scale lines 50 μm .



from L. Pedder, Tas., 13.5-14.3°C; pH 4.6-6.1; 33.0-38.7 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Koste et al. 1988.

Lecane ruttneri Hauer

FIG. 14:5

Lecane ruttneri Hauer, 1938, p. 523, Fig. 46a, b.

Diagnosis: Lorica outline rectangular; head aperture margins coincident, weakly convex, dorsal margin wider than ventral; corner spines absent; dorsal plate narrower than ventral, tapers to truncate posterior margin; both surfaces weakly ornamented as figured; lateral sulci absent; posterior segment bilaterally constricted, rounded posteriorly; second foot segment not projecting beyond caudal margin; toes $\frac{1}{5}$ body length, straight on inner margin, tapering on outer margin to short, acute claw.

Dorsal plate 53x48 μm ; ventral plate 62x50 μm ; anterior margins 46 μm (dorsal), 40 μm (ventral); toes 17-19 μm ; claws 6 μm .

Distribution: Indonesia. Single record, L. Boorl, Vic. 20.0°C; pH 7.4; DO 8.8 mg l⁻¹, 1500 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978.

Lecane signifera (Jennings)

FIG. 14:6

Distyla signifera Jennings, 1896, p. 92, Figs 1, 2.

Lecane signifera: Harring 1913, p. 62.

Diagnosis: Head aperture margins coincident, straight; two small cusp-like spines at external angles; unusual lorica ornamentation; bead-like hemispheres closely spaced on slopes of elevated ridges; shallow lateral sulci; posterior segment projects slightly beyond dorsal plate; toes $\frac{1}{5}$ total length, ending in acute points without claws.

Dorsal plate 124-135x90-96 μm ; ventral plate 136-148x82-88 μm ; toes 52-60 μm .

Distribution: Cosmopolitan, possibly acidophile. Rare; N.T., Qld, Tas., Vic. 20.0°C; pH 7.4; DO 8.8 mg l⁻¹, 1500 $\mu\text{S cm}^{-1}$.

Comment: A subspecies, *Lecane signifera ploenensis* (Voigt 1902) (Fig. 15:1) also known from N.S.W., N.T., Qld. It has larger cusps at the external angles than *L. signifera*, and may be larger in some dimensions, although probably subject to ecotypic variation.

Dorsal plate 80-185x66-112 μm ; ventral plate 90-185x55-185 μm ; toes 35-86 μm .

Literature: Koste 1978, 1981; Shiel & Koste 1979.

Lecane stichaea Harring

FIG. 15:2

Lecane stichaea Harring, 1913, p. 397, Fig. 35:4-6.

Diagnosis: Head aperture margins coincident, slightly convex; two stout cusps at external angles; intricate surface markings on both dorsal and ventral plates as figured; lateral sulci shallow; ventral plate parallel-sided, considerably narrower than dorsal; posterior segment projects well beyond truncate dorsal plate; second foot segment extends $>\frac{1}{2}$ its length beyond posterior margin; toes $>\frac{1}{4}$ total length, ending in acute claw without basal spicule.

Dorsal plate 85-92x69-76 μm ; ventral plate 75-97x to 75 μm ; toes 27-39 μm ; claws 5.7 μm .

Distribution: Cosmopolitan in standing waters, springs. Rare: three records, all flowing waters; Magela Ck, N.T., R. Murray, S. Aust. and Macquarie R., Tas. *L. stichaea intrasinuata* (Olofsson 1917) (Fig. 15:3) also occurs in the Magela Ck region. It may be difficult to distinguish from *L. stichaea*, however the dorsal lorica generally is smooth or weakly sculptured, and most dimensions are larger.

Dorsal plate 61-105x78-85 μm ; ventral plate 63-110x 41-72 μm ; toes 24-45 μm ; claws 5-7 μm .

Literature: Koste 1978.

Lecane subtilis Harring & Myers

FIG. 15:4

Lecane subtilis, Harring & Myers, 1926, p. 370, Fig. 30, 5, 6.

Diagnosis: Anterior lorica almost rectangular; head aperture margins slightly convex, coincident; no frontal spines; very distinctive ornamentation of both surfaces as figured; dorsal plate rounded posteriorly, same width as ventral plate, slightly shorter; lateral sulci indistinct; second foot segment projects slightly; toes ca. $\frac{1}{6}$ total length with long slender claw.

Dorsal plate 54-70x50-60 μm , ventral plate 60-75x50-55 μm , anterior width 56 μm , toes 25-32 μm , claws 5-8 μm .

Distribution: Probably cosmopolitan. Not recorded in this study. Unconfirmed report from Sunbury, Victoria.

Literature: Koste 1978; Berzins 1982.

Lecane tasmaniensis Shiel & Koste

FIG. 15:5

Lecane tasmaniensis Shiel & Koste, 1985, pp. 7-8, Fig. 3.

Diagnosis: Head aperture margins straight,

Fig. 16. 1, *Lecane tuberculata* Harring & Myers: (a) dorsal; (b) ventral. 2, *L. ungulata* (Gosse): (a) dorsal; (b) ventral; (c) *L. ungulata australiensis* Koste, dorsal; 3, *L. venusta* Harring & Myers: (a) dorsal; (b) ventral. 4, *L. spenceri* (Shephard), ventral. Fig. 16: 1, 2a, 3, after Harring & Myers (1926); 2b, c, after Koste (1979). 4, after Anderson & Shephard (1892). Scale lines 50 μm .

coincident; prominent frontal cusps; smooth dorsal plate wider than ventral plate, slightly truncate posteriorly; ventral plate with transverse fold over first foot joint, with two longitudinal lines running anteriorly; toes < $\frac{1}{2}$ body length, parallel-sided to short claws with basal spicules.

Total length 155-158 μm , dorsal plate to 115x86 μm , ventral plate to 126x79 μm , anterior margin 58 μm , toes 61 μm , claws 10-12 μm .

Distribution: Apparently endemic to Tasmania (west coast and Tasman Peninsula). 10-19.0°C, pH 3.1-5.8, 26-334 $\mu\text{S cm}^{-1}$.

Lecane tenuiseta Harring

FIG. 15:6

Lecane tenuiseta Harring, 1914, p. 543, Fig. 22:1-3.

Diagnosis: Head aperture margins parallel, slightly convex; dorsal plate smooth, rounded posteriorly; ventral plate with series of ridges; lateral sulci shallow; posterior segment broad, rounded, protrudes beyond dorsal plate; second foot segment not protruding; toes long, slender, ca. $\frac{1}{3}$ total length, terminating in extremely long spinelike claw.

Dorsal plate 64-78x56 μm , ventral plate 57-83x56 μm , toes 20-33 μm , claws 13-18 μm .

Distribution: Cosmopolitan, eurytopic. Two records, N.T., W.A. 25.0°C, pH 5.9, DO 2.2 mg l^{-1} , 29 $\mu\text{S cm}^{-1}$.

Lecane tudicola Harring & Myers

FIG. 16:1

Lecane tudicola Harring & Myers, 1926, p. 328, Fig. 11:1, 2.

Diagnosis: Head aperture margins not coincident; dorsal straight, ventral with shallow V-shaped sinus; two small cusps at external angles; smooth dorsal plate narrower than ventral both anteriorly and posteriorly, similar width medially; ventral plate smooth; lateral sulci shallow; posterior plate broad, rounded, with two lateral indentations, projects beyond dorsal plate; second foot segment does not reach lorica rim; toes ca. $\frac{1}{4}$ total length, taper to acute points, no claws.

Dorsal plate 105-120x85-104 μm , ventral plate 110-140 μm , anterior width 58-96 μm , toes 37-48 μm .

Distribution: Asia, N. and S. America. Unconfirmed record from Victoria.

Literature: Koste 1978; Berzins 1982.

Lecane unguilata unguilata (Gosse)

FIG. 16:2a, b

Cathypna unguilata Gosse, 1887, p. 361, Fig. 8:1

Lecane unguilata: Harring, 1913, p. 62.

Diagnosis: Head aperture margins not coincident; dorsal almost straight, ventral slightly concave; two large triangular cusps at external angles; smooth

dorsal plate smaller than ventral, with indistinct anterior margin (Fig. 16:2a); ventral plate with single indistinct transverse fold; lateral sulci deep; posterior segment broad, covers foot; toes > $\frac{1}{3}$ total length, end in long stout claw with basal spicule.

Dorsal plate 140-220x138-180 μm , ventral plate 185-255x139-195 μm , toes 73-120 μm , claws 20-45 μm .

Distribution: Cosmopolitan. Rate: N.T., Qld. 24.5°C, pH 5.4-6.3, DO 4.8-6.2, 23-59 $\mu\text{S cm}^{-1}$, alkal. 2.7-4.1 mg l^{-1} .

Comment: A variant, at present considered a subspecies (*Lecane unguilata australiensis* Koste, 1979) (Fig. 15:2c) is known from Magela Crk, N.T. and Goulburn R., Vic. billabongs. It has a distinctive median dome on the dorsal anterior lorica margin, and is considerably larger than *L. unguilata*.

Dorsal plate 230-240x184-200 μm , ventral plate 268-280x216-240 μm , toes 120-130 μm , claws 20-45 μm .

Literature: Koste 1978, 1979, 1981.

Lecane venusta Harring & Myers

FIG. 16:3

Lecane venusta Harring & Myers, 1926, p. 328, Fig. 27.

Diagnosis: Head aperture margins not coincident; dorsal slightly convex, ventral nearly straight; no corner spines; both surfaces with complex ornamentation as figured; posterior segment broadly rounded, projects beyond dorsal plate; second foot segment visible beyond posterior segment; toes long and slender, incurved to acute points; no claws.

Dorsal plate 86x75 μm , ventral plate 84x70 μm , anterior margins 62 μm , toes 42 μm .

Distribution: N. America, U.S.S.R. Rare. Not recorded in this study. Unconfirmed record from Victoria.

Literature: Koste 1978; Berzins 1982.

Incertae sedis

A lecanid resembling *L. luna* was described by Anderson & Shephard (1892) from Brighton, Vic., but with some hesitation regarded as new. It was not named, and the figure (redrawn in Fig. 16:4) of doubtful quality. Subsequently, Shephard (1892) gave a brief redescription and named the rotifer *Cathypna* (=*Lecane*) *spenceri*. Harring (1913) accepted *L. spenceri*, but in view of the lack of taxonomically accurate figures we must regard it as *incertae sedis*, even though the description suggests it may be a valid species.

The original description is reproduced below, and *L. spenceri* is included in the *Lecane* key for ready identification should it be encountered again. It is

notable that other taxa described as new by Anderson & Shephard (1892) and Shephard (1911) (e.g. *Brachionus dichotomus*; *B. lyra*), but synonymised with northern hemisphere taxa by later reviewers, subsequently were validated as distinctive Australian endemics (see Koste & Shiel 1987b).

Lecane spenceri Shephard
FIG. 16:4

Cathypna cf. luna Anderson & Shephard, 1892, p. 77, Fig. 12:4.

Cathypna spenceri Shephard, 1892, p. 15.
Lecane spenceri, Harring, 1913, p. 62.

Diagnosis: Resembles *L. luna*; ... the points of difference are ... in the lorica being broader anteriorly and the dorsal occipital edge more deeply excavated, the posterior possessing more of a lobed character, having a decided inward curve on either side and a rounded termination overhanging the toes; the most marked departure being in the setting of the claws, which, instead of tapering from the shoulder to the end, are recessed so as to form a recessed barb; the surface of the lorica was also 'stippled' (Shephard 1892).

Assuming Shephard's figure is drawn to scale, the given length (1/130" or 192 µm) suggests that the approximate measurements of this lecanid are: dorsal plate 111×109 µm, ventral plate 144×109 µm,

anterior width 83 µm, toes 43 µm, claws 13 µm, i.e. comparable in size to *L. luna*.

Distribution: Recorded from Brighton, Vic. No other details given.

Acknowledgments

This work was supported by Australian Biological Resources Study grants to collect in Tasmania (RJS), and to defray graphic costs (WK). Some ecological data were collected during a zooplankton ecology project funded by an Australian Research Grants scheme grant (to RJS) at the Botany Department, University of Adelaide. Our thanks to the then Chairman, George Ganf, and the secretarial staff, Bronwyn Burns and Carol Robinson, for access to word-processing and photocopying facilities. Final stages of MS preparation were at the Murray-Darling Freshwater Research Centre, Albury, also the source of much of our material from the upper Murray over a ten year period. This material, particularly collections by John Hawking, Terry Hillman and Don Omond, is gratefully acknowledged. Collectors acknowledged in our earlier papers also contributed further material to this work. Their assistance is appreciated. The Deutschen Forschungsgemeinschaft, Bonn-Bad Godesburg, provided microscope and photographic facilities to WK.

References

- ALLSTROM, E.H. (1938) Plankton Rotatoria from North Carolina. *J. Elisha Mitchell Soc.* 54, 88–110.
- ANDERSON, H.H. & SHEPARD, J. (1892) Notes on Victorian rotifers. *Proc. R. Soc. Vict.* 4, 69–80.
- BARTOS, E. (1959) Virnici — Rotatoria. *Fauna C.S.R.* 15, 1–969.
- HERZINS, B. (1982) Contribution to the knowledge of Rotatoria of Australia. (University of Lund, Lund.)
- BIENERT, R.W. Jr (1986) A new species of *Lecane* (Rotifera: Lecanidae) from subtropical Florida. *Hydrobiologia* 141, 175–177.
- BRYCE, D. (1891) Remarks on *Distyta*, with descriptions of three new rotifers. *Sci. Gossip* 27, 204–206.
- (1892) On some moss-dwelling Cathypnidiae; with descriptions of five new species. *Sci. Gossip* 28, 271–275.
- CHENGALAKH, R. & FERNANDEZ, C.H. (1973) Rotifera from Sri Lanka (Ceylon). I. The genus *Lecane* with descriptions of two new species. *Bull. Fish. Res. Sta. Sri Lanka (Ceylon)* 24, 13–27.
- DALAY, E. VON (1897) Uj-Guineai Rotatoria. *Math. termesz. Ertes.* Budapest 15, 131–148.
- (1905) Paraguay műkincsa faunájának alaprajza. *Ibid* 23, 312–355.
- ECKSTEIN, K. (1883) Die Rotatorien der Umgegend von Giessen. *Zeits. Wiss. Zool. Leipzig* 39, 343–443.
- EDMONDSON, W.T. (1935) Some Rotatoria from Arizona. *Trans. Am. Microsc. Soc.* 54, 459–473.
- (1936) New Rotatoria from New England and New Brunswick. *Ibid* 55, 214–222.
- EBREMBERG, C.G. (1830) Organisation, Systematik und geographisches Verhältniss der Infusionsthierchen. *Abh. Akad. Wiss. Berl.* (for 1828 and 1830), pp. 1–108.
- (1832) Zur Kenntnis der Organisation in der
- Richtung des kleinsten Raumes. 2. Entwicklung, Lebensdauer und Struktur der Magenthiere und Räderthiere, oder sogenannten Infusorien, nebst einer physiologischen Characteristik beider Klassen und 412 Arten derselben. *Abh. Akad. Wiss. Berl.* (for 1831), pp. 1–154.
- (1834) Beitrag zur Erkenntnis grosser Organisation in der Richtung des kleinsten Raumes. 3. *Ibid* (for 1833), pp. 145–336.
- EVANS, J. (1951) The rotifer record of Victoria. *Proc. Microsc. Soc. Vict.* 4–7.
- FAJEEV, N. (1925) Materialien zur Rotatorienfauna des SSSR. Kurze Diagnosen neuer Rotatorien der russischen Fauna. *Russk. Gidrobiol. Zh.* 4, 72–74.
- GOSSE, P. H. (1851) A Catalogue of Rotifera found in Britain, with descriptions of five new genera and thirty-two new species. *Ann. Mag. Nat. Hist. Ser. 2*, 8, 197–203.
- (1887) Twenty-four new species of Rotifiers. *J. R. Microsc. Soc.* 1–7.
- GREEN, J. (1981) Associations of rotifers in Australian crater lakes. *J. Zool. (Lond.)* 193, 469–486.
- HARRING, H. K. (1913) Synopsis of the Rotatoria. *Bull. Am. Mus.* 81, 1–226.
- (1914) Report on Rotatoria from Panama with descriptions of new species. *Proc. U.S. Natl. Mus.* 47, 525–564.
- & MYERS, F. J. (1926) The rotifer fauna of Wisconsin. III. A revision of the genera *Lecane* and *Monostyla*. *Trans. Wis. Acad. Sci. Arts Lett.* 22, 315–423.
- HAUER, J. (1929) Zur Kenntnis der Rotatoriengenera *Lecane* und *Monostyla*. *Zool. Anz.* 83, 143–164.

- (1931) Zur Rotatiorienfauna Deutschlands. II. *Ibid.* 93, 7-13.
- (1936) Räderthiere aus dem Naturschutzgebiet Weingartner Moor. *Beitr. naturk. Forsch. SW-Deutschl.* I, 129-152.
- (1938) Die Rotatoren von Sumatra, Java und Bali nach der Ergebnissen der Deutschen Limnologischen Sunda-Expedition. II. *Arch. Hydrobiol. Suppl.* 15, 507-602.
- HERRICK, C. L. (1885) Notes on American rotifers. *Bull. Sci. Lab. Dennison Univ., Ohio* 1, 43-62.
- HIMSON, C. T. & GROSS, P. H. (1886) The Rotifera or wheel-animalcules, both British and foreign. 2 vols. (Longman, London.)
- JAKUBSKI, A. W. (1912) Beiträge zur Kenntnis der Süßwassermakrofauna Ostafrikas. I. Die Räderthiere der Usangasteppe. *Zool. Anz.* 39, 536-550.
- JENNINGS, H. S. (1896) Report on the Rotatoria, with description of a new species. *Bull. Mich. Fish Comm.* 6, 85-93.
- KOSTE, W. (1962) Über die Räderthierfauna des Darnsees in Epe bei Brunsbüttel, Kreis Dithmarschen. *Krifff-Naturw. Ver. Osnabrück* 30, 73-137.
- (1978) Rotatoria. Die Räderthiere Mitteleuropas. Bestimmungswerk begründet von Max Voigt. 3 vols. (Bornträger, Stuttgart).
- (1979) New Rotifera from the River Murray, southeastern Australia, with a review of the Australian species of *Brachionus* and *Keratella*. *Aust. J. Mar. Freshwat. Res.* 30, 237-253.
- (1981) Zur Morphologie, Systematik und Ökologie von neuen monogononten Räderthieren (Rotatoria) aus dem überschwemmungsgebiet des Magela Creek in der Alligator River Region, Australiens, N.T. Teil I. *Osnabrücker naturwiss. Mitt.* 8, 97-126.
- & SHIEL, R. J. (1980) New Rotifera from Australia. *Trans. R. Soc. S. Aust.* 104, 133-144.
- & — (1983) Morphology, systematics and ecology of new monogonont Rotifera from the Alligator Rivers Region, N.T. *Ibid.* 107, 109-121.
- & — (1986a) New Rotifera (Aschelminthes) from Tasmania. *Ibid.* 110, 93-109.
- & — (1986b) Rotifera from Australian inland waters. I. Bdellida (Rotifera: Diganota). *Aust. J. Mar. Freshwat. Res.* 37, 765-792.
- & — (1987a) Tasmanian Rotifera: affinities with the Australian fauna. *Hydrobiologia* 147, 31-43.
- & — (1987b) Rotifera from Australian inland waters. II. Epiphanidae and Brachionidae (Rotifera: Monogononta). *Invert. Taxon.* 1, 949-1021.
- & — (1989a) Rotifera from Australian inland waters III. Euchlanidae, Mytilinidae and Trichotrichidae. *Trans. R. Soc. S. Aust.* 113, 85-114.
- & — (1989b) Rotifera from Australian inland waters. IV. Colurellidae. *Trans. R. Soc. S. Aust.* 113, 119-143.
- & — & BROOKS, M. A. (1983) Rotifera from Western Australian wetlands, with descriptions of two new species. *Hydrobiologia* 104, 9-17.
- & — & TAN, L. W. (1988) New rotifers (Rotifera) from Tasmania. *Trans. R. Soc. S. Aust.* 112, 119-131.
- KUTIKOVA, I. A. (1970) [Rotifer fauna of the U.S.S.R., subclass Euturbatoria]. *Fauna CCCP* 104, 1-744. (Akad. Nauk. CCCP, Leningrad.) [Russian.]
- MELISSNIKOV, V. I. (1908) [Zooplankton of the Aral Sea and the inflowing rivers, in connection with the question of their distribution requirements.] *Izv. Turkestan. Otd. Imp. Russk. Geogr. Obshch.*, Tashkent 4, 1-102. [Russian.]
- MILLER, G. F. (1776) 'Zoologieae Daniae prodromus, sed animalium Daniae et Norvegiae indigenarum characteres, nomina, et synonyma imprimis populatim.' (Copenhagen). 282 pp.
- (1786) 'Animalcula infusoria fluvialia et marina, quae defixit, systematicae descriptio et ad vivum delineari curavit.' (Copenhagen.) 367 pp.
- MURRAY, J. (1906) The Rotifera of the Scottish lochs. *Trans. R. Soc. Edinb.* 45, 145-191.
- (1913a) South American Rotifera. *J. R. Microsc. Soc.*, 341-362.
- (1913b) Australasian Rotifera. *Ibid.* 455-461.
- (1913c) Notes on the family Cathypnidae. *Ibid.* 545-564.
- MYLES, F. J. (1917) Rotatoria of Los Angeles, California and vicinity with descriptions of a new species *Priscella*. *U.S. Nat. Mus.* 52, 472-478.
- (1937) Rotifera from the Adirondack region of New York. *Am. Mus. Nov.* 903, 1-17.
- NITSCH, C. I. (1827) Cerearia, Allg. Ency. Wiss. Künste 16, 66-69.
- OLDESSON, O. (1917) Süßwasser-Entomostriaken und Rotatoren von der Murmanskküste und aus dem nördlichsten Norwegen. *Zool. Bidr. Uppsala* 5, 259-294.
- (1918) Studien über die Süßwasserauf Spitzbergens. *Ibid.* 6, 183-648.
- PAX, F. & WILLETT, K. (1941) Die Rotatoren Deutscher Schwefelquellen und Thermen. *Arch. Hydrobiol.* 38, 165-213.
- REINKE, A. (1929-1933) Rotatoria. In 'Klassen und Ordnungen des Tierreichs'. (Ed. H. L. Bronn) 4, 1-576.
- RUSSELL, C. R. (1961) The Rotatoria of Queensland, Australia. *Trans. R. Soc. N.Z. N.S.* 1, 235-239.
- SCHMIDT, L. K. (1859) Neue wirbellose Tiere beobachtet und gesammelt auf einer reise um die Erde 1853 bis 1857. Leipzig 1, 1-66.
- SHEPHERD, J. (1892) Note on a new rotifer. *Vest. Nat.* 9, 15.
- SHIEL, R. J. & KUNSTE, W. (1979) Rotifera recorded from Australia. *Trans. R. Soc. S. Aust.* 103, 57-68.
- & — (1985) New species and new records of Rotifera (Aschelminthes) from Australian waters. *Ibid.* 109, 1-15.
- SHIEL, R. J., WALKER, K. L. & WILLIAMS, W. D. (1982) Plankton of the lower River Murray, South Australia. *Aust. J. Mar. Freshwat. Res.* 33, 301-327.
- STENKOUS, K. E. (1898) Das Thierleben im Nurmijärvi See. Finnlandsche biologische Studie. *Acta Soc. Flora Fenn. Fenn.* 17, 1-259.
- STOKES, A. C. (1896) Some new forms of American Rotifera. *Ann. Mag. Nat. Hist. Ser.* 6, 18, 17-27.
- STRZELECKI, M. & TIMMS, B. V. (1977) A new species of *Brachionus* (Rotifera) from the Myall Lakes, New South Wales. *Proc. Linn. Soc. N.S.W.* 101, 162-166.
- TATE, R. D., SHIEL, R. J. & KUNSTE, W. (1984) Structure and dynamics of zooplankton communities, Alligator Rivers region, N.T. Australia. *Hydrobiologia* 103, 1-13.
- TYRER, C. H. (1892) Notes upon the Cladocera, Copepoda, Ostracoda and Rotifers of Cincinnati, with descriptions of new species. *Bull. Sci. Lab. Dennison Univ., Ohio* 6, 58-74.
- VOIGT, M. (1957) 'Rotatoria. Die Räderthiere Mitteleuropas.' 2 Vols. (Bornträger, Berlin.)
- WISZNIOWSKI (1953) Fauna wód kroków Polski i regionów przyległych. *Pol. Arch. Hydrobiol.* 1, 317-490.
- (1954) Matériaux relatifs à la nomenclature et à la bibliographie des Rotifères. *Ibid.* 2, 7-249.
- WILFERT, K. (1963) Räderthiere aus einigen afrikanischen Gewässern. *Limnologica* (Berlin) 3, 347-366.
- (1966) Rotatoren aus dem Stausee Ajwa und der Trinkwasser-Aufbereitung der Stadt Baroda (Indien). *Ibid.* 6, 405-416.
- YAMANOKO, K. (1955) A new rotifer (Order Plochini) from Japan. *Ann. Zool. Japon.* 28, 33-34.